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DESIGN — CONSTRUCTION — OPERATION

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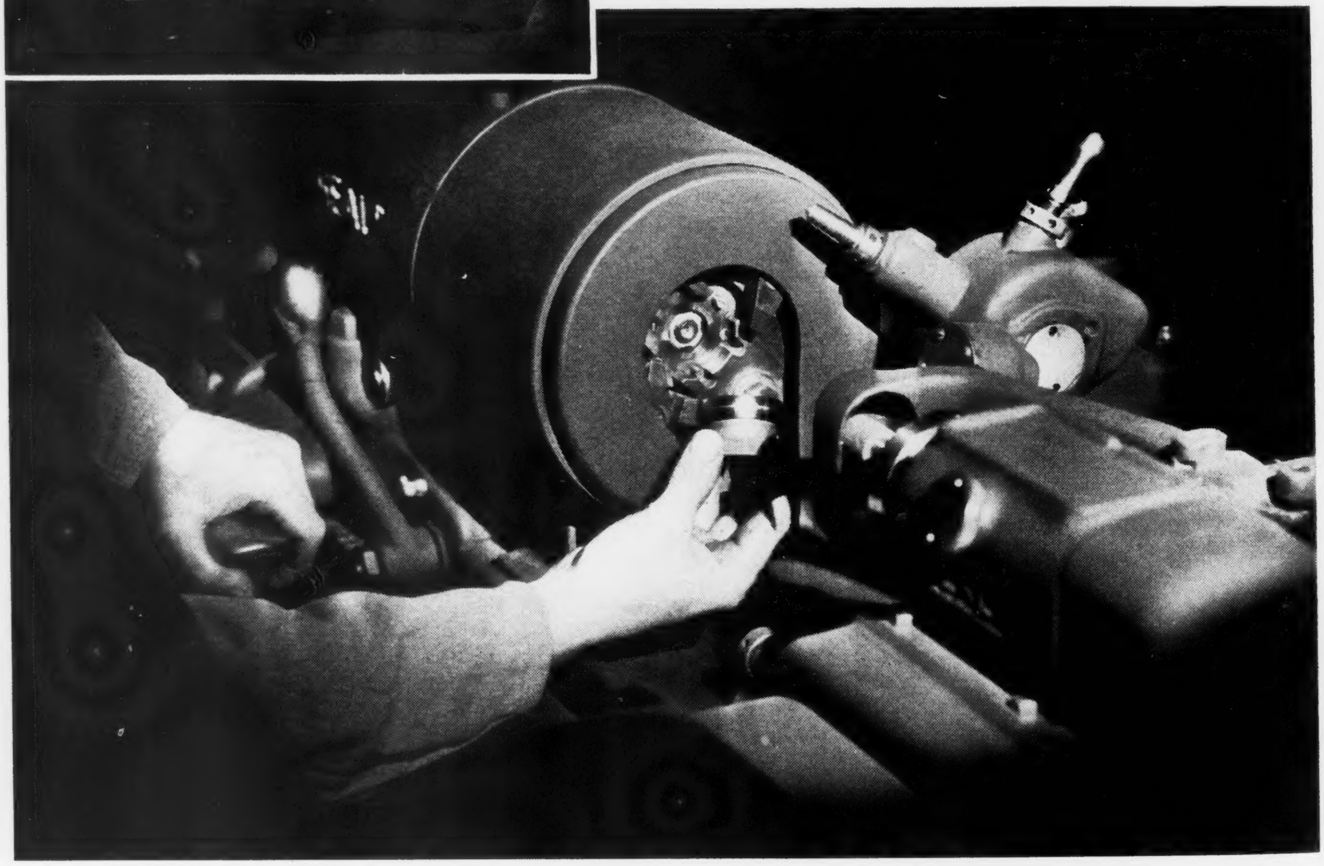

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MACHINERY

Volume 39 NEW YORK, OCTOBER, 1932 Number 2

Equipping for the New Needs of Industry

A Brief Summary of the Practical Possibilities which the Latest Machine Tools, Shop Equipment, and Materials Offer the Manufacturer who is Endeavoring to Make a Better Product as well as to Reduce Manufacturing Costs

ENGINEERING progress has made very rapid strides during the last two or three years, general business conditions notwithstanding. The remarkable development that has taken place in machine tools and shop equipment has never been surpassed during any equal period in the past. Many causes have contributed to this; but whatever the cause, the all-important fact remains that equipment now available makes it possible to get results in manufacturing operations that were not obtainable even a short time ago.

What these new possibilities are and what they mean to a manufacturing plant in meeting the keen competition of the present day is a matter of vital importance to every man in a responsible position in the manufacturing industries.

The advance in engineering practice is much like the action of the tide. It moves up slowly, but steadily. Everyone knows that the advance is taking place, but does not realize its full extent until a comparison of the high and low points is made. It is the object, therefore, in a series of articles to be published in this and following numbers of MACHINERY, to review briefly some of the outstanding features in this remarkable development and to illustrate, by examples selected from shops throughout the country, the application of modern shop equipment to specific operations.

In a brief review of this kind, it is not claimed that these improvements are covered with any degree of completeness. The object is to indicate trends and possibilities—to show what these new developments mean to manufacturers using shop equipment—rather than to attempt to review in detail the achievements of the machinery builders that produce the "master tools of industry."

The great development that has taken place has obviously been stimulated and accelerated by the introduction of super-hard cutting tools, but it has by no means been entirely dependent upon this new factor in machine shop operation. On the contrary, many of the developments were well under way long before the full significance of the new cutting tools became apparent; and in machine tools that do not depend upon metal tools for their operation—like grinding machines—the developments have been fully as marked as in the other types.

Briefly, the newer types of machines have three characteristics that differentiate them from former designs. First, they have greater power, which implies that they are heavier, sturdier, and more compactly designed; second, they have a greater range of speed, which implies increased production possibilities and greater adaptability to the work to be performed; and, third, their control and operation have been greatly simplified through the introduction of electric and hydraulic means of control and more effective mechanical means of operation.

A few years ago, many of the standard types of machines were thought to have practically reached the limit of their development. It did not appear that much could be done to improve these machines, either as regards capacity or facility of operation; and yet, today, the new designs are in many re-

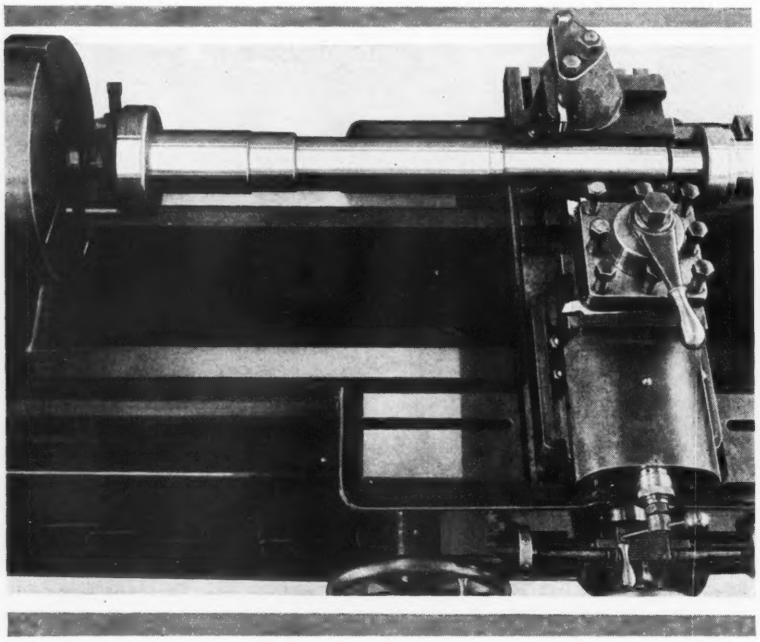


Fig. 1. Turning, Facing, and Necking Lathe Spindles on a 24-inch Lodge & Shipley Manufacturing Lathe in 13.5 Minutes per Spindle, Floor-to-floor Time, Using Multiple Length and Diameter Stops and Four-way Tool-block

spects so different from those assumed to have reached a certain finality of perfection that they have ushered in an entirely new era in machine shop practice.

This is true, for example, of the basic machine tools—lathes, planers, shapers, and drilling machines—as well as of boring mills and horizontal boring machines. Modern 16- and 20-inch lathes, provided with 10- and 20-horsepower motors, differ as radically from lathes of that size built ten years ago as those earlier lathes differed from the conventional lathe at the beginning of the century.

Similarly, a dozen years ago, there were those who said, "There is not much that can be done in the way of improving planer design. The planer has become standardized." Yet the planers of today are provided with so many features that were not even hinted at in earlier designs, and are susceptible of such simple and complete control from one position, that they have made the older machines become completely obsolete in many respects, quite apart from the greater power and rigidity of the newer machines.

A similar comparison can be made between the shapers of today and those of a comparatively few years ago; and these remarks apply equally to drilling machines. The conventional type of upright drilling machine so generally used some twenty years ago can hardly be recognized in the newer types, nor is there any similarity except in general outline between the radial drilling machines of today and those of a few years ago.

A Comparison of Results Obtained with Present and Earlier Types of Machines

Milling and grinding machines have undergone an even more obvious development. The constantly increasing capacity, weight, and power of milling machines has been accompanied by a corresponding increase in actual efficiency—that is, in increased

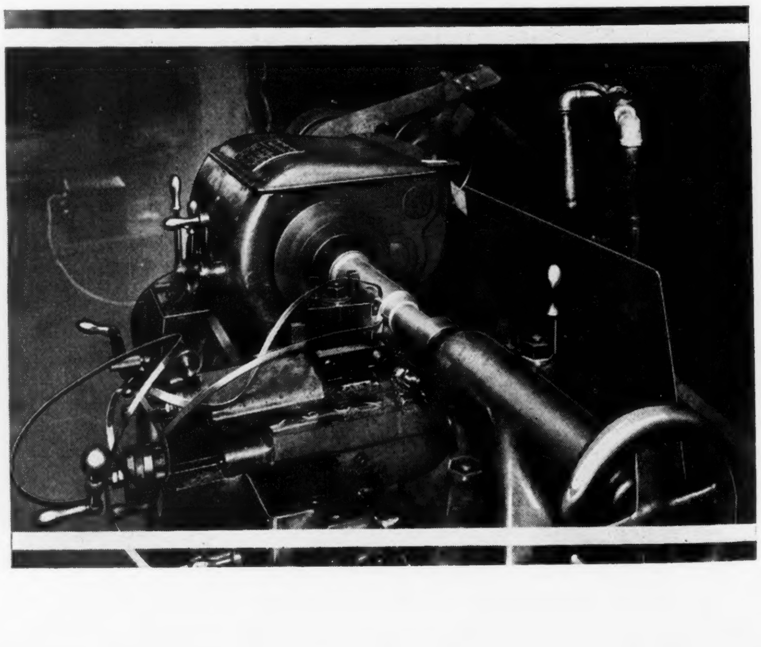


Fig. 2. Removing 89 Cubic Inches of 20-point Carbon Steel a Minute from a 4-inch Bar with a Tantalum-carbide Tool in a 16-inch Reed-Prentice Lathe with a Speed of 502 Feet per Minute, a 1/2-inch Depth of Cut, and a 0.034-inch Feed per Revolution—a Demonstration of the Practical Application of Recent Developments

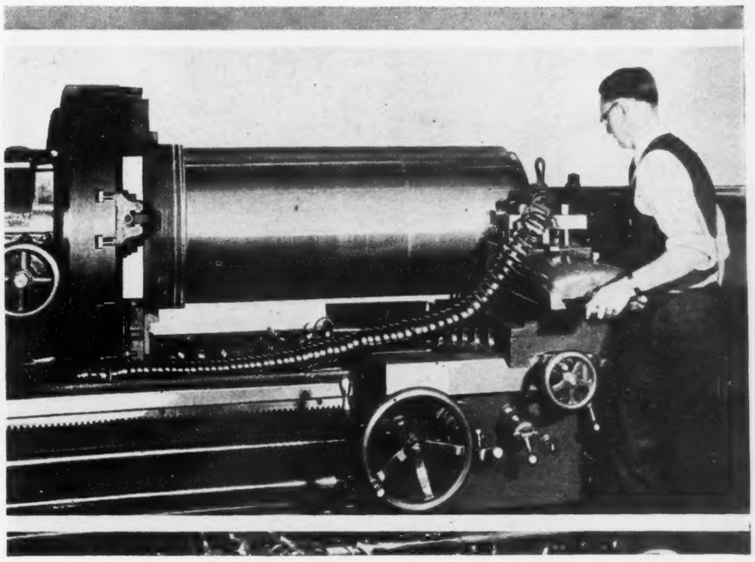


Fig. 3. Turning a Nickel-steel Forging with a Cemented-carbide Tool at a Speed of 225 Feet per Minute on a 42-inch American Tool Works "Super-productive" Lathe, Indicating the Adaptability of the New Tools for Turning Alloy Steel

metal-removing capacity per horsepower. The following data are of interest as an illustration of this: In 1907, it was considered good practice if a milling machine removed 1/2 cubic inch per horsepower per minute with a high-speed steel cutter; in 1918, nearly 1 cubic inch could be removed; and, at the present time, 1 1/2 cubic inches per horsepower per minute is not an unusual performance. To what extent tungsten-carbide cutters will make possible still further improvements in this direction has not yet been accurately determined.

By the combination of improved milling machines and better fixtures, tremendous increases in production have been made possible. Take, for example, the splitting and straddle-milling of connecting-rods and trace the developments from 1910 to the present time. In 1910, the production was 40 connecting-rods per hour; in 1920, it had risen to 90 per hour; in 1926, to 110 per hour; and, at the present time, 250 pieces per hour are milled in one machine of standard type with an automatic indexing fixture.

The tremendous increase in productive capacity of grinding machines is exemplified by a record of production in the grinding of valve tappets. Machines available in 1920 would grind 90 pieces; in 1923, 150; in 1925, 300; in 1927, 450; and at the present time, 1350. Furthermore, the present type of machine does not require one operator for each machine; instead, three machines can be operated by one man.

The development of cemented-carbide tools and their application to machine tools was so completely covered in numerous articles in May and June MACHINERY, this year, that the effect of the new super-hard cutting tools will not be dealt with in detail at this time. It is well known that the effect of these tools on machine tool design has been tremendous and that cutting speeds unheard of five years ago are now commonplace in many plants engaged in production work. Cast-iron and semi-steel castings are regularly being turned at a cutting speed of from 250 to 280 feet per minute; brass and bronze at from 425 to 450 feet per minute; and cast aluminum at 1000 feet per minute. Similar cutting speeds are used in milling these materials.

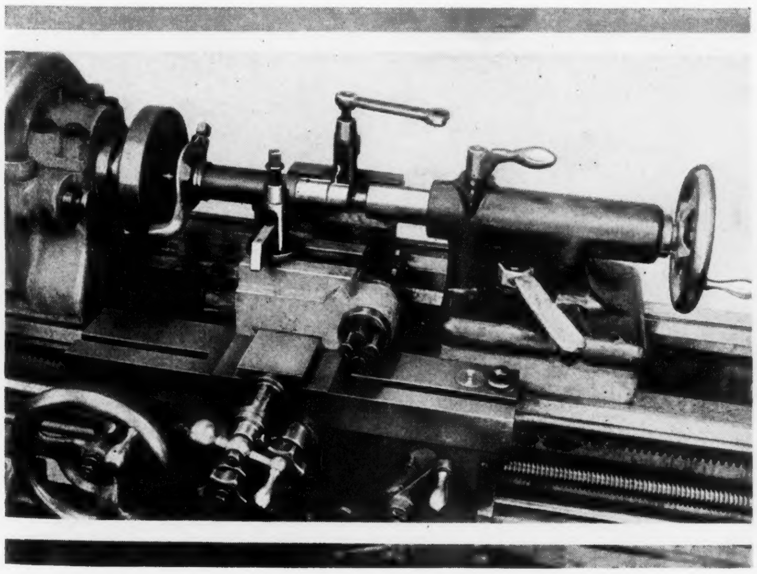


Fig. 4. Cincinnati Lathe & Tool Co.'s Lathe Equipped for the Rapid Machining of Shouldered Shafts. The Tool in the Front Holder Turns the Different Diameters, while the Square-nose Tool in the Independently Adjustable Rear Holder Necks the Shaft for Grinding. Micrometer Stops Control the Diameters and Length of the Cuts. Four, Six or Eight Diameter Stops are Available

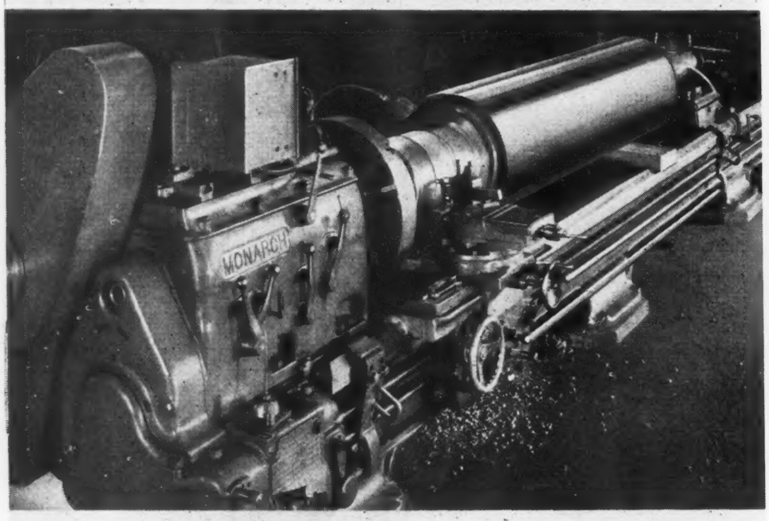


Fig. 5. Machining a 28-inch Diameter 19,000-pound Paper Mill Roll on a 36-inch by 32-foot Monarch Lathe. The 16-inch Journal Bearings on the Roll are Being Turned Down to 12 Inches in Diameter to Fit Roller Bearings

A Few of the Significant Developments in Lathes

Up-to-date designs of lathes are capable of about three times the speeds of former designs. This development has carried with it a requirement for better bearings; ball and roller bearings are now frequently used in the head and gear-boxes, and occasionally for the entire tailstock-spindle as well. Because of the higher speeds, better lubrication means have been introduced.

The power has been increased from two to three times, especially in machines built for production work, using the new carbide tools. With greater power comes greater rigidity, which means beds of heavier cross-section, heavier tool-rests and carriages, and greater sturdiness in the tailstock.

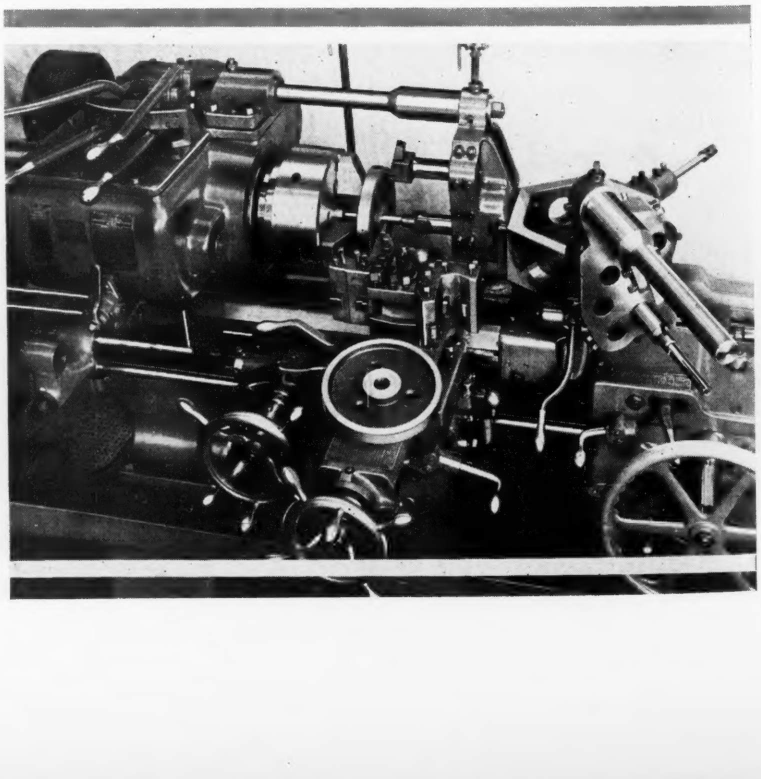
These general remarks apply not only to engine lathes, but, in a large measure, to turret lathes and automatic lathes as well. As an example of the added power capacity of turret lathes may be mentioned the case of a No. 1 universal turret lathe provided with a 25-horsepower variable-speed motor, coupled directly to the spindle and having a maximum spindle speed of 1600 revolutions per minute. No. 5 turret lathes have been built with motors up to 100 horsepower.

Speeds from four to six times as fast as those formerly employed have been provided in automatic lathes, some of which are now designed with hydraulic feeds.

A 100-Horsepower Engine Lathe

Ordinarily, lathes of 22-inch swing are designed for a power input of about 15 horsepower, have twelve spindle speeds, and weigh approximately 8000 pounds. Compare such a standard machine with one of the same swing recently built. This lathe is designed for a 100-horsepower input, has 140 spindle speeds ranging from 33 to 1200 revolutions per minute, and weighs 40,000 pounds. It was built for one of the large electrical manufacturers, to determine the maximum metal-cutting capacities of cemented-carbide cutting tools.

Fig. 6. Alloy-steel Forgings for Tractor Gears, 10 Inches in Diameter by 1 1/4 Inches Thick, are Straddle-faced, Turned, Bored and Counterbored in 7.4 Minutes on a Warner & Swasey Turret Lathe Equipped with a 12-inch Logan Air Chuck



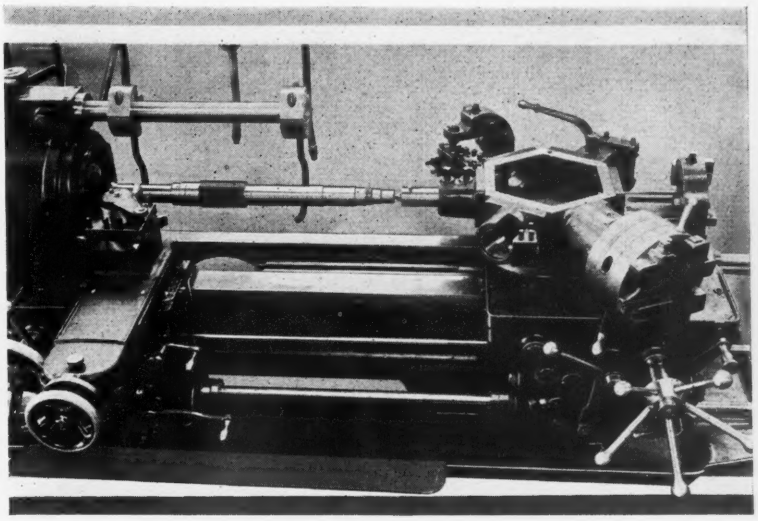


Fig. 7. Gisholt Turret Lathe Equipped for Machining Electric Motor Armature Shafts in 22 Minutes Floor-to-floor Time—a Little Less than Half the Time Formerly Required. The Shaft is 3 Inches Diameter by 37 Inches Long

With this machine, up to 162 cubic inches of metal has been removed per minute. An interesting feature of the machine is that the feed mechanism is entirely separate from and independent of the lathe spindle, being driven by an individual three-horsepower motor.

A Set-Up for Finish-Turning Lathe Spindles

As an example of the application of modern engine lathes to commercial production, and of the speed with which the work can be performed, the following typical job was selected. Lathe spindles are finish-turned complete, including the facing of shoulders and the turning of grinding necks, in 13.5 minutes, floor-to-floor time, on the lathe set-up shown in Fig. 1. This production time is made possible through the use of multiple length and diameter stops, connected compound and plain rests, and a four-way tool-block. The tantalum-carbide turning tool permits the use of a cutting speed up to 340 feet per minute.

Two Lathes of Huge Size

A giant roll lathe in which rolls up to 82 inches in diameter and 26 feet in length can be handled has been built recently. This machine is 49 feet long and the bedplate alone weighs over 67 tons. It is claimed to be the largest roll lathe in the world, as regards capacity, power, and weight. Its modern design is attested by the fact that it is equipped with roller bearings throughout.

A lathe was recently built for the U. S. Navy Yard at Bremerton, Wash., which has a capacity for machining propeller shafts up to 60 feet long. This lathe has a swing of 42 inches and an over-all length of 80 feet.

Increased Spindle Speeds are a Feature of Many Modern Lathes

Spindle speeds up to 3000 revolutions per minute are obtainable in recent high-speed engine lathes of 16-inch size. Automatic length feed-stops are becoming a feature on several modern lathes. The introduction of stops on lathes, so arranged that feed motions will be thrown out automatically with certainty and accuracy, is a development that is meeting with the approval of the users of lathes in manufacturing work. One operator may run several machines without danger of spoiling work.

Another improvement in some engine lathes is

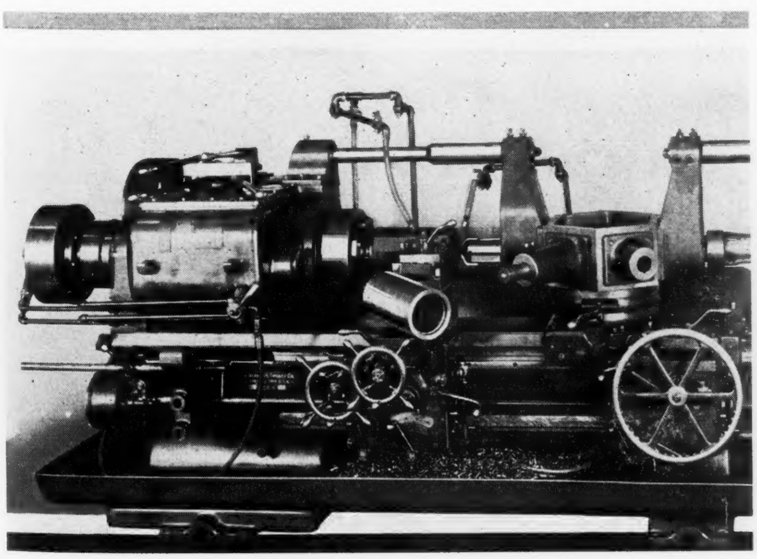


Fig. 8. Forgings of SAE 3150 Steel, 8 Inches in Diameter by 14 Inches Long, are Held on a Logan 16-inch Cylinder Air-operated Expanding Arbor while being Machined in a Warner & Swasey Heavy-duty Turret Lathe

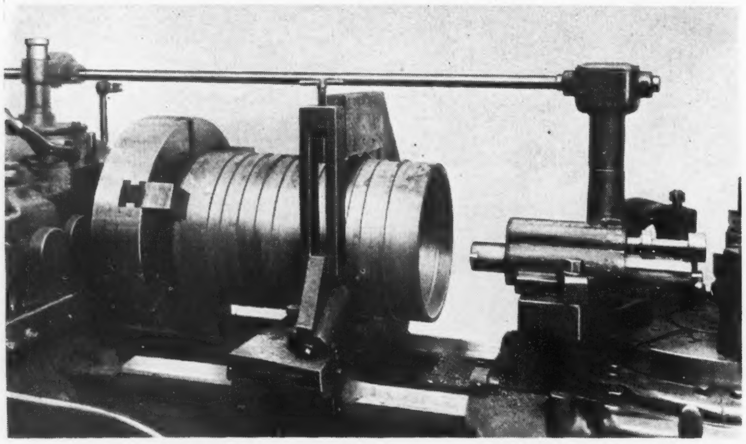


Fig. 9. Jones & Lamson Turret Lathe Tooled for Boring, Necking, Chamfering, and Threading Operations on Cast-iron Cam-drums. Floor-to-floor Time, 30 Minutes—Note Steadyrest Capable of Crosswise Adjustment

the method of guiding and holding the carriage to the bed; at the front and back, the carriage is guided by large vees, while a wide flat bearing supports it under the bridge where the tool pressure comes. Gibs are located in the center of the bed on square guides in order to keep the carriage from being lifted under the heaviest cuts, and also to strengthen the bridge.

Selected Examples of Turret Lathe Performance

The motor armature shaft shown in Fig. 7 is machined in 22 minutes, floor-to-floor time, with the turret-lathe set-up illustrated. This production time is a little less than half the former time. The shaft is 3 inches in diameter and 37 inches long. Tools mounted on the turret machine the outer end, while tools in the square turret on the cross-slide machine the opposite end. A carrier is provided for catching the work when it is cut off from the bar stock.

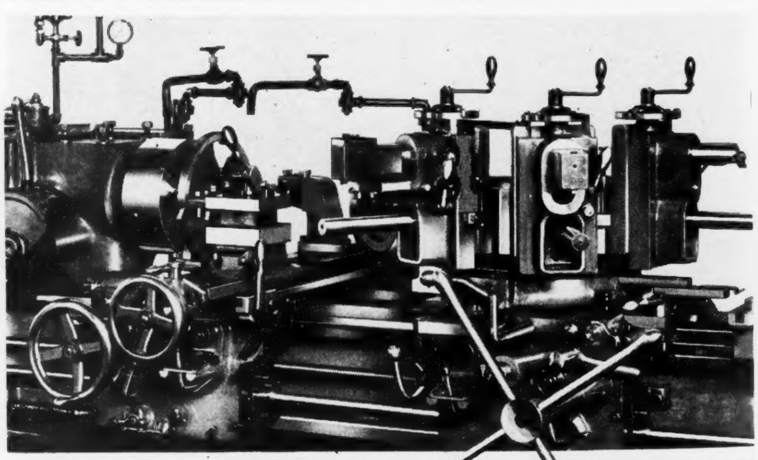
Rapid Boring and Threading of Cam-Drums

Cast-iron cam-drums for Fay automatic lathes are chucked in a turret lathe, as shown in Fig. 9, for boring, necking, chamfering, and threading on the inside of one end. The floor-to-floor time for these operations is 30 minutes. The threading is done with an automatic thread-chasing attachment. A special feature of the machining equipment is the steadyrest, which is mounted on a dovetail block that permits crosswise adjustment.

Machining Seat-Rings for Gate Valves and Hydrant Pipe Stands

The production rates on brass, Monel metal, and stainless steel seat-rings for gate valves have been greatly increased by a semi-universal turret lathe equipped as shown in Fig. 10. An air chuck, with pressure regulator and equalizing chuck jaws of different sizes, together with adjustable tool-blocks on the turret, provides for machining rings from 6 to 15 inches in diameter. Multiple roughing and finishing cuts are taken, notwithstanding the small section of the rings.

Fig. 10. Acme Semi-universal Turret Lathe Tooled up for Rapid Production of Stainless Steel Seat-rings for Gate Valves—Adjustable Tool-blocks and Air Chuck with Interchangeable Jaws Provide for Machining Rings from 6 to 15 Inches in Diameter



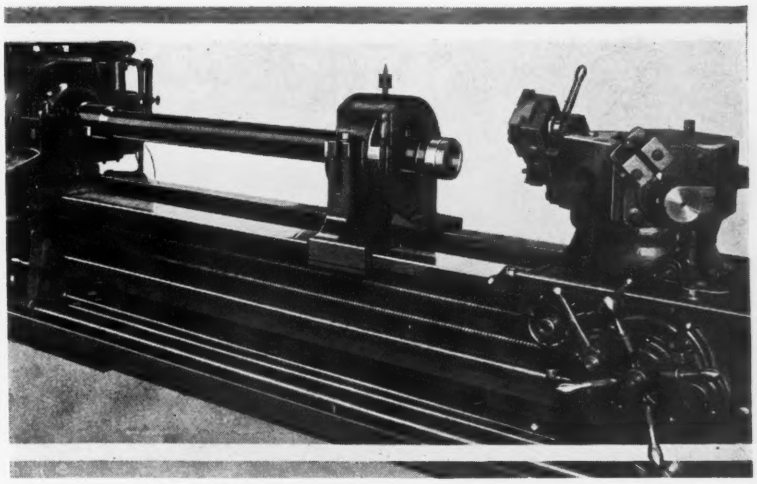


Fig. 11. Machining Hydrant Pipe Stand on an International Machine Tool Co.'s Libby Turret Lathe. Production Increased from 9 to 30 Pieces a Day—The Pipe is Chucked on an Air-operated Mandrel

Machining operations on hydrant pipe stands are being performed very rapidly on a turret lathe equipped as shown in Fig. 11. With this equipment, production has been increased from 9 to 30 pieces a day. This increase has been made possible by the rigidity of the lathe bed (which permits heavy cutting at a point 8 or 9 feet from the headstock), the efficiency of the tool equipment, and the fact that the driving motor can be controlled at any operating position. The pipe is chucked on an air-operated mandrel. One end is machined by tools mounted on the side carriage, while the other end is machined by tools held in the turret.

Faster Machining of Small Castings Facilitated by Small-Size Turret Lathe

Small aluminum, iron, brass, or bronze castings can be machined at spindle speeds up to 2200 revolutions per minute, with feeds of from 0.005 to 0.020 inch, on the small turret chucking machine shown in Fig. 12. Castings up to about 6 inches in diameter, such as shown in the chuck, can be finished on several surfaces with this machine, the same as with larger turret lathes.

The four-position turret is mounted on a sliding base with a cross-feed screw having a large micrometer dial. The saddle has four positive stops. The controls and general construction are similar to those of large turret lathes designed for heavier work.

Machining Straight and Tapered Locomotive Frame Bolts at High Rate of Speed

Locomotive frame bolts, like the one on the cross-slide of the universal turret lathe illustrated in Fig. 13, are machined in a floor-to-floor time of 1 minute 55 seconds with the equipment shown. This bolt has a maximum diameter of 2 inches, a tapered body 12 inches long, and a straight threaded end 3 inches long. The taper-turning is done in one cut.

Each bolt must be turned to fit a reamed hole that has been accurately gaged. These requirements are easily met, as the operator can quickly set the tool for turning the bolt to the required size by simply turning the dial shown on the front of the turret attachment until the graduation indicating the correct diameter is opposite the index mark.

Guide bolts with straight bodies are machined in a similar manner in 1 minute 30 seconds floor-to-floor time, and guide yoke bolts with tapered bodies are machined in 1 minute 15 seconds. Cross cylinder and binder bolts are machined in 2 minutes 24 seconds and 2 minutes 30 seconds, respectively.

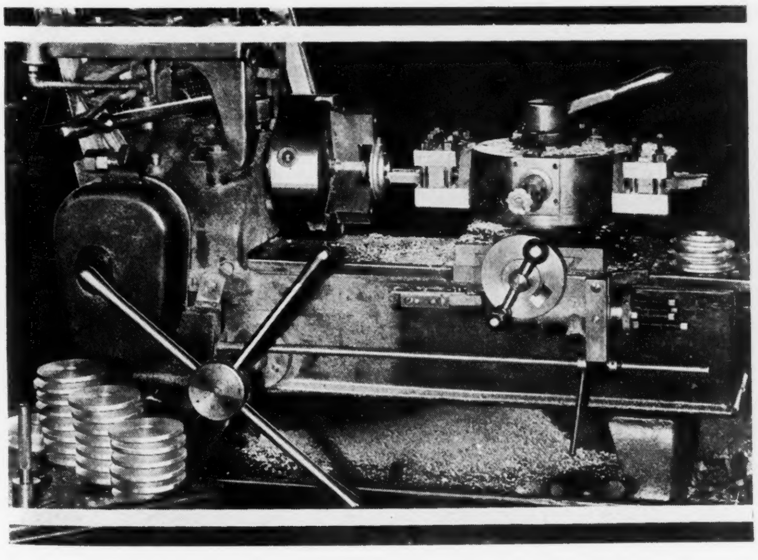


Fig. 12. Small-size Porter-Cable Turret Lathe Built for the Rapid Machining of Small Castings—Capable of Spindle Speeds up to 2200 Revolutions per Minute, with Feeds Varying from 0.005 to 0.020 Inch per Revolution

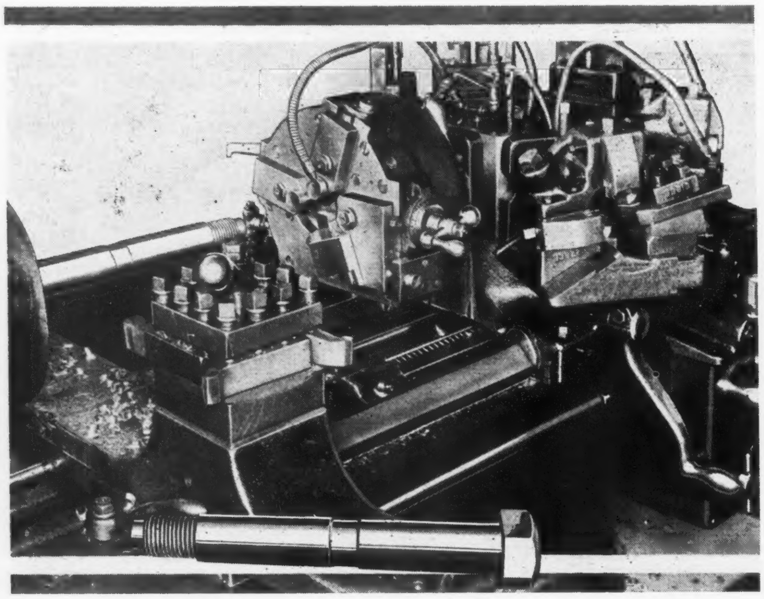


Fig. 13. Foster Universal Turret Lathe with Taper-turning and "Quick-size" Adjustment Features, Machining Locomotive Frame Bolts in Less Than One-third the Time Previously Required—Maximum Diameter of Bolt 2 Inches; Tapered Part, 12 Inches Long; Straight Threaded End, 3 Inches Long; Floor-to-floor Time, 1 Minute, 55 Seconds

The examples shown, selected from a wide variety of shops making products applicable in many industrial fields, could be multiplied indefinitely. Enough have been shown, however, to indicate how, through the application of the greatly improved machines available today, the manufacturers of the thousand-and-one products of industry, as well as the repair shops of our transportation systems, may profit by the improved equipment at their disposal.

It has frequently been pointed out that the value of improved shop equipment can be demonstrated, not only in times of great business activity, but in times of reduced activity as well. When competition is keener than ever, the ability to manufacture at decreased machining costs is perhaps of even greater importance, for, as has been well said, "In good times the difference between good equipment and poor is mainly a matter of greater or less profits; but in quiet times, it may mean the difference between breaking even and losses in large red figures."

Hence, a study of the cost-saving possibilities indicated by the examples shown in this and following articles is a matter of real importance to industry at this time.

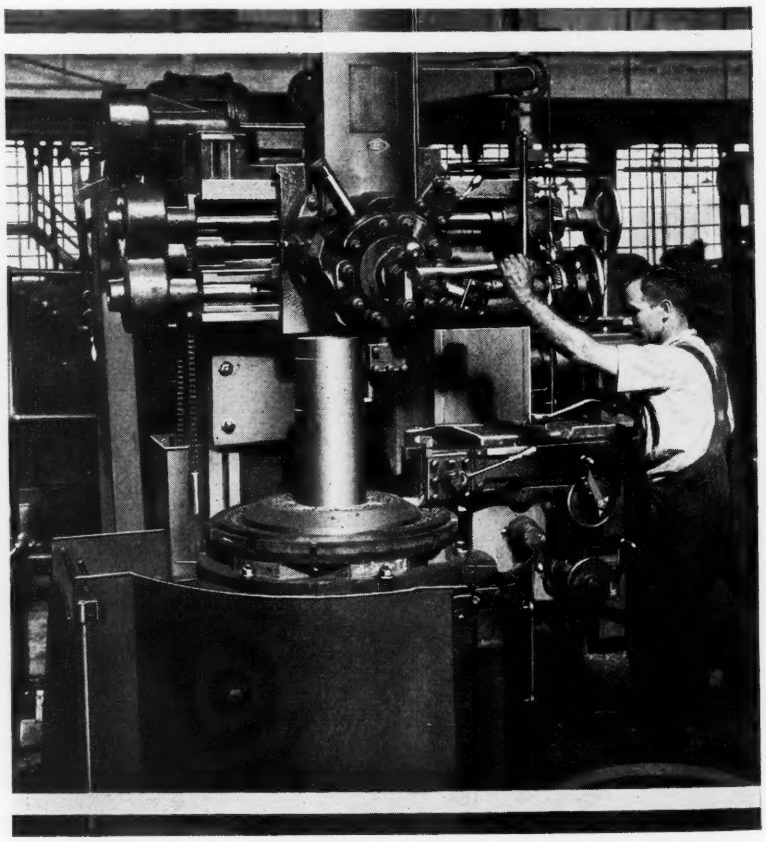


Fig. 14. A Job Performed on a Bullard Vertical Turret Lathe with a Saving of 51 Per Cent Over the Best Previous Floor-to-floor Time. By Using Carbide Tools for Some of the Operations, an Additional Saving of 18 Per Cent of the Former Time May be Made, Effecting a Total Saving of 69 Per Cent in Machining Time

Automatic Lathes Fill New Requirements in Machine Shop Practice

Equipping for the New Needs of Industry
Section 2

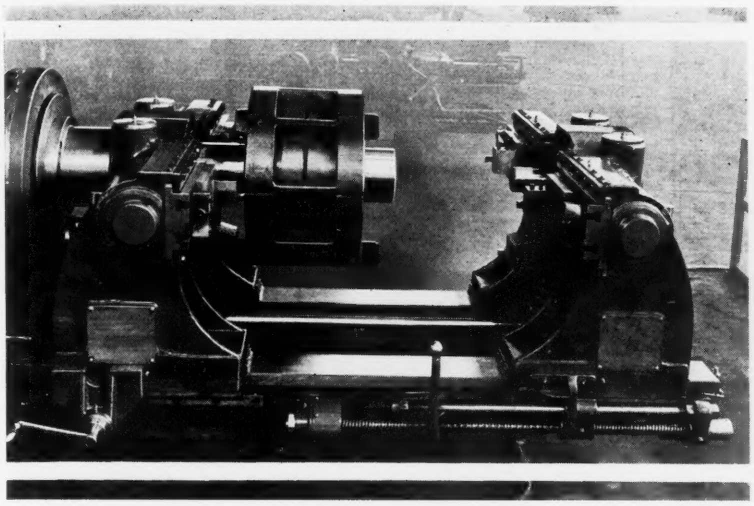


Fig. 1. Gisholt Simplimatic Lathe Tooled to Finish the Rabbet Fit on Both Sides of a Motor Frame at the Rate of 15 to 20 an Hour

AUTOMATIC lathes have been developed in two types. One is quite universal as regards the work to which it may be applied; the other is more definitely designed for a particular kind of work. As an example of an automatic lathe of the latter class may be mentioned a machine designed primarily for machining short stubby work, such as ball-bearing races, gear blanks, and similar pieces that can be held either on an arbor or in a chuck. Spindle speeds up to 2000 revolutions per minute are available to provide for the use of the new carbide cutting tools. Such machines, of course, are provided with anti-friction bearings for all the rapidly revolving shafts and spindles. In some of these machines, the control mechanism for moving tool-slides, opening and closing chucks, etc., is hydraulically operated.

The flexibility of automatic lathes of recent design permits set-ups of great simplicity. For example, in one lathe of this type, both sides of an automobile ring gear are faced, the hole is rough- and finish-bored, the bore is chamfered, and one outside corner is rounded by tools mounted on one cross-slide, which is hydraulically operated. The floor-to-floor time for this operation is one minute. By substituting another set of auxiliary slides on the cross-slide, the same machine is used for the second operation. In this operation, two surfaces inclined at different angles are turned and, at the same time, the inside of the tooth ring is bored.

In another automatic lathe, with two carriages and tool-slides hydraulically and automatically controlled, both the front and rear carriages may be equipped with a length feed and quick traverse, and the front and rear tool-slides may be provided with a cross-feeding travel and quick traverse. Either tool-slide can be instantly reversed and returned to the starting position from any point in the cycle. Positive adjustable diameter and length stops insure duplication of cuts and a reduction in

Fig. 2. A LeBlond Automatic Equipped for Machining Both Ends of Rear Axle Housings in One Operation. Production, 18 an Hour

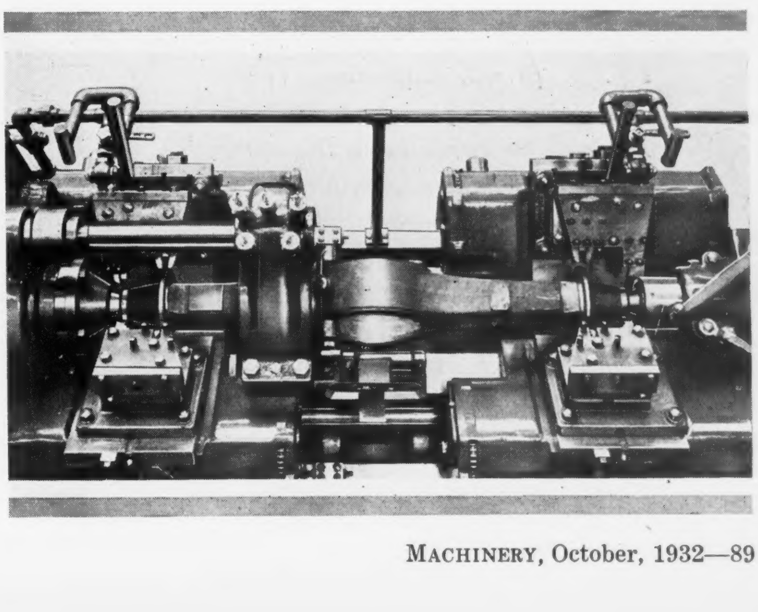
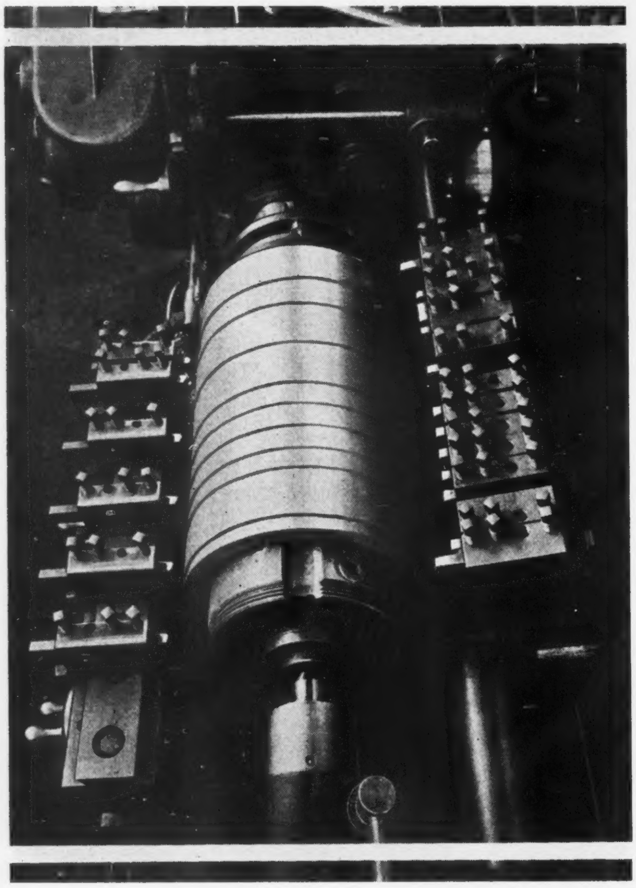


Fig. 3. (Below) Fay Automatic Lathe Tooled for Machining the Outside and the Ends of Cast-iron Cam-drums. Floor-to-floor Time 15 Minutes



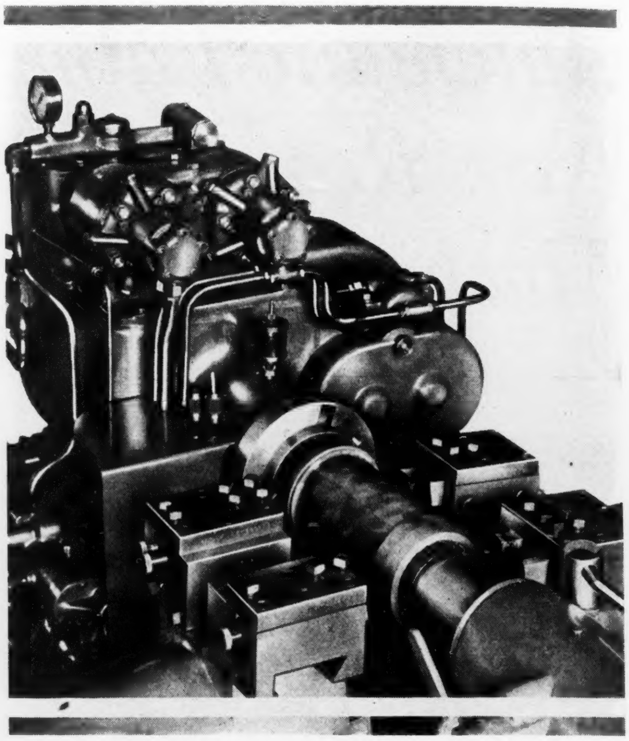
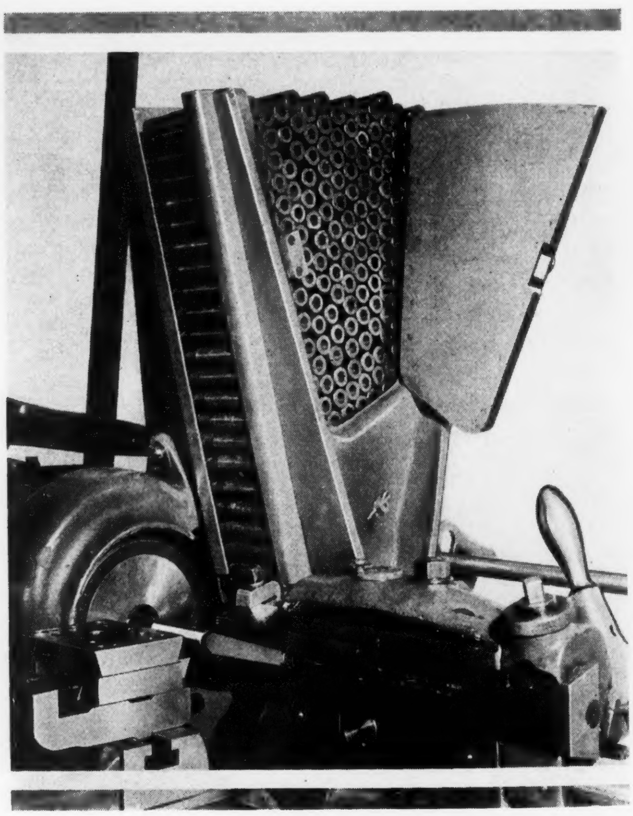


Fig. 4. (Above) A John S. Barnes Automatic Lathe Turning Cast-iron Cylinder Sleeves with Cemented-carbide Tools at Speeds up to 350 Feet per Minute

Fig. 5. (Right) Cast-iron Valve Stem Guides for Automobile Engines are Turned to a Diameter of 11/16 Inch for a Length of 2 1/2 Inches and Faced on Both Ends at the Rate of 15 Seconds Each in a Pratt & Whitney Full Automatic Lathe. The Special Magazine Takes 300 Pieces at One Loading



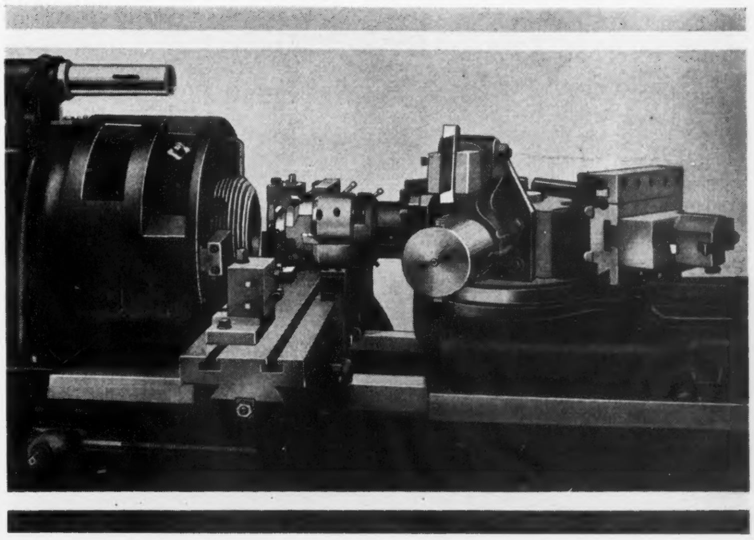


Fig. 6. Cylinder Head Castings of Aluminum Alloy Machined at the Rate of 13 an Hour by One Operator Tending Two Potter & Johnston Power-Flex Automatics

set-up time. The feeding rate can be varied automatically and instantly.

An automatic hydro-electric arrangement is employed on another automatic lathe for controlling the starting and stopping of the spindle and slides. No clutch is employed on this equipment. A variable-speed motor drives the machine, power being delivered direct to the spindle through multiple V-belts. The spindle rotates clockwise, or opposite to the direction of spindle rotation in conventional lathes. Feed dials are provided for regulating the feeding rate of each carriage.

An automatic hydraulic lathe has been designed for turning the line bearings of automobile crankshafts, and the stub and flange ends as well. This machine is built with either a double-end drive or with a center drive, and will machine an eight-throw crankshaft with nine line bearings. The tools are actuated by a hydraulic cylinder located in a compartment at the center of the machine.

An automatic crankpin-turning and cheek-facing lathe, built especially for the high speeds and increased feeds made possible by the newer cutting tools, weighs approximately 44,000 pounds and is capable of handling either four-, six-, or eight-cylinder automobile crankshafts. Hydraulic feed and push-button control are features of this machine. A crankshaft is completed in 22 seconds.

A large variety of form-turning operations can be controlled automatically on the type of form-turning lathes that automatically reproduce the shape of a thin master templet. These machines are suitable for such work as turning die-casting dies, molding and forming dies, spinning chucks, formed cutters, and metal-bending rolls, and for turning and facing any special shapes that can be reproduced in the form of the master templet. This templet may be made of sheet steel, zinc, brass, or other metal, and its form is reproduced within limits as close as 0.001 inch.

Several high-production lathes of special design intended for rough- and finish-facing or rough- and finish-forming are available. These machines are generally automatic in their cycles of operation, the only duty of the operator being to load and unload the work and to manipulate a starting lever. As examples of work performed on machines of this type may be mentioned automobile pistons and ball-crank handles.

Among the outstanding developments in connection with automatic machines are automatic loaders for groups of machines by means of which, as has been well said, "automatic machines are made truly automatic." A number of automatic machines are placed side by side, each machine performing, in sequence,

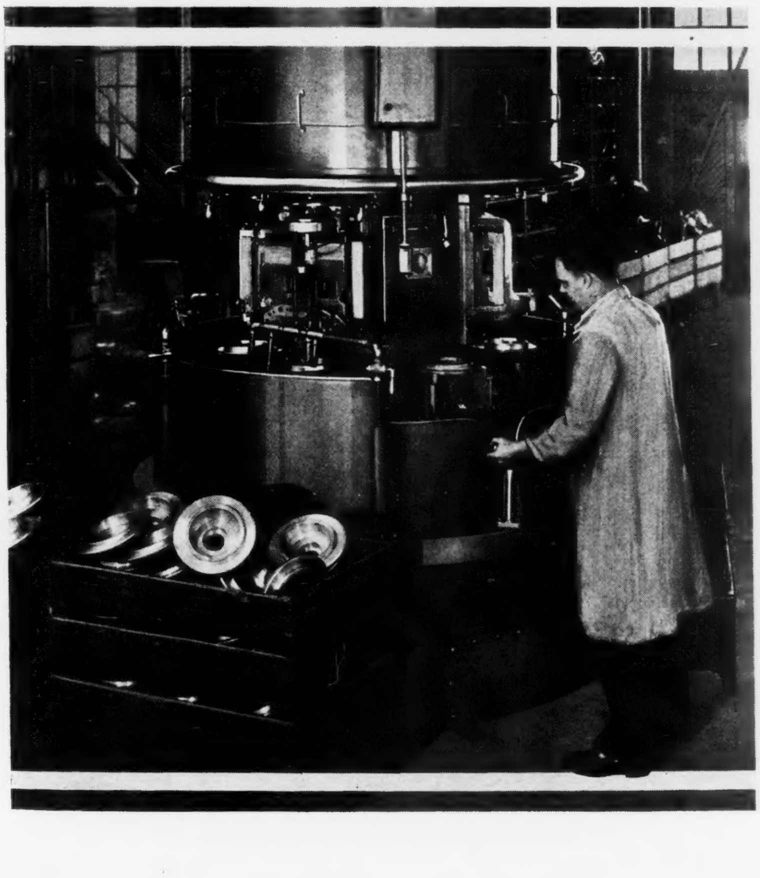


Fig. 7. A Bullard Mult-Au-Matic Engaged in Machining a Flange with a Very High Degree of Accuracy, Necessitated by the Close Fit Required for the Mating Piece. One of the Surfaces is an Accurately Produced Spherical Shape

some operation on a piece of work. The work comes to the first machine from a magazine and is automatically placed in the operating position. When the operation is completed, the work-piece is transferred to the next machine by means of travelling carriers mounted above the machines, and is automatically placed in position for the operation to be performed. From this machine it is transferred automatically to the next one, and so on until completed, when it passes through a chute from the last machine. Such equipment can be arranged to turn the work end for end, if required, while the pieces are being passed from one machine to the next.

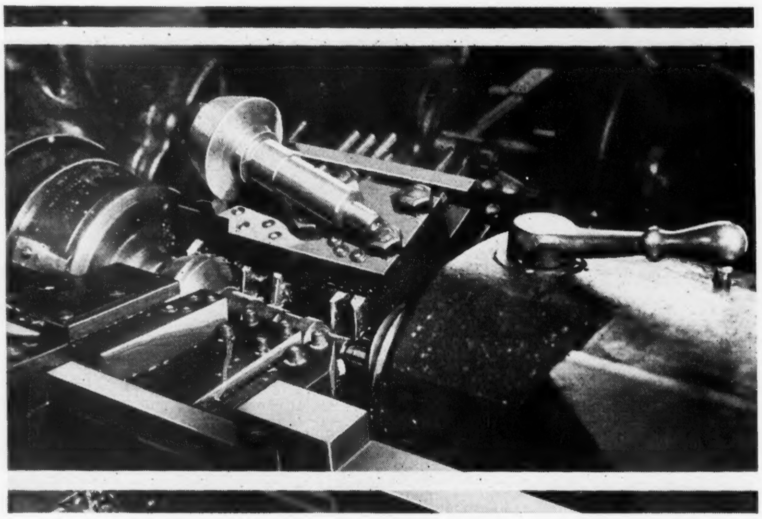


Fig. 8. Machining Stem Pinions on a Seneca Falls Automatic at the Packard Motor Car Co.'s Plant

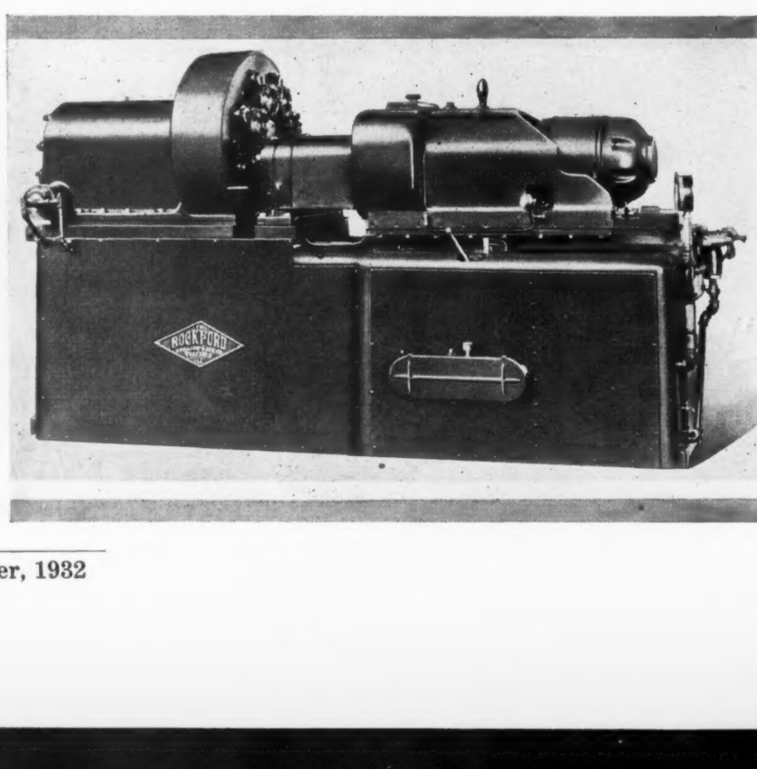
The accompanying illustrations show a number of typical applications of automatic lathes. The rabbet fit on both sides of motor frames is machined simultaneously on the machine shown in Fig. 1, in 3 to 4 1/2 minutes, floor-to-floor time, depending on the size of frame. The movements of the tools are automatic. The tools in the front slides on the two heads rough-face the work, while those in the rear slides finish-face it, and those in the lower slides turn the rabbet fits. Tungsten-carbide tools are used throughout.

The axle housings for automobile trucks are machined on an automatic machine equipped as shown in Fig. 2 at the rate of 18 finished axle housings an hour. This is double the production obtained with previous equipment. The machine has two carriages and a special center-drive head, and is entirely automatic in operation. After loading the machine, the operator simply throws the starting handle. This causes the tools to rapidly traverse to the work, slow down for the cutting operation, and then return to their starting positions by rapid traverse.

Cast-iron cam-drums for the Fay automatic lathe are rough- and finish-machined on the outside in machines of the same type as the ones on which they are to be used. Fig. 3 shows one of the cam-drums mounted in two three-jaw chucks held on a bar which is gripped by a driving chuck at one end and supported by the lathe center at the outer end. This set-up rough-turns the outside, rough-straddle-faces the ends, and rough-machines all grooves. A similarly equipped machine finishes these surfaces. The floor-to-floor time for each of these operations is 15 minutes.

High surface speeds, with maximum feeds, are used in machining cast-iron cylinder sleeves in automatic lathes equipped as shown in Fig. 4. These machines have hydraulic feeds, and are equipped with cemented-carbide tools. The roughing operations are performed at speeds from 225 to 300 surface feet per minute with feeds varying from 0.030 to 0.040 inch per revolution; the finishing operations, at speeds of from 250 to 350 surface feet per minute, with feeds from 0.015 to 0.025 inch per revolution.

Fig. 9. Oil-grooving and Burnishing Two Parts at a Time in a Seven-second Cycle on a Rockford Drilling Machine Co.'s Automatic



In the machine shown in Fig. 9 two parts are loaded and unloaded at one time at the idle stations. While the loading takes place, two parts have oil-grooves cut in their faces at the first working station, and two parts, previously grooved, are burnished at the second working station. The cycle is wholly automatic.

Recent Advances in Electric Motor Applications

THE tendency to employ individual motors for the various motions in machine tools of many different kinds is marked. There is a growing recognition of the greater flexibility of the fully electrified machine. A horizontal boring, milling, and drilling machine, for example, has been provided with more than a dozen motors for operating the different movements of the machine. The control is concentrated in one place, clutches are eliminated, and the demand for ease of operation has been met to a remarkable degree. Vertical boring mills have also been designed in which every motion has its own motor, practically eliminating all clutches. A recently designed planer shows the same tendency. Every feed movement is provided with its own individual motor, eliminating mechanical connections. A large slotter has a dozen motors, including individual motors for clamping slides.

Present Trends of Electric and Hydraulic Drives

This tendency to use individual motors for the various movements of a machine is especially of value in general-purpose machines. For special-purpose machines, hydraulic operation is preferred by many designers and users; but even in this case, there appears to be a tendency to use individual motors for operating the feed motions, the rapid traverse, etc.

Even on hydraulically operated machines, several independent motors may be used. In one case, for example, one motor is employed for driving the hydraulic pump, while two separate motors are used for the drive for the cutting tools.

On some machines, hydraulic motions have been replaced by direct-connected motors. A case in point is a special machine employing one main driving motor, two motors for traversing the tools, and seven other auxiliary motors to replace the hydraulic system. Pneumatic operation has also been replaced in several instances by motors.

It should be noted, however, that there are certain machines and certain feed motions for which the characteristics of the hydraulic feed is still preferred; and for such cases, hydraulic feed motions are likely to remain definitely in favor with both designers and users.

There is a marked tendency toward the use of adjustable-speed motors applied directly to the main spindle, thereby eliminating intermediate gearing. Such direct connection of the motor is used especially for large machines, and for cases where it is of importance to eliminate any possible marks on the finished product. An example in point is the turning of commutators where an exceptionally smooth cut is of importance. Lathes and horizontal boring mills are typical machines for which adjustable-speed motors applied directly to the spindle or table have been used.

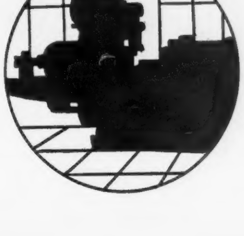
Another development in motor drive that greatly facilitates the operation of many different types of machine tools is the accuracy with which motors may be stopped. On a large cylindrical grinding machine, it has been found possible to stop the table feed and the traverse motion within limits of 0.0015 inch. This means that motors may actuate accurately predetermined movements with the same precision as mechanical stops.

It is also possible to synchronize motors used for different motions in a machine in a manner that will provide an accuracy similar to that obtained when the movements are synchronized by gears.

Statistics covering the lines of a number of large machine tool manufacturers indicate that from 1922 to 1932 there was an increase of over 100 per cent in the horsepower of machine tools having identical size designations. The increase from 1927 up to the present time is 45 per cent. This means that where a 5 horsepower motor was sufficient ten years ago, a 10 horsepower motor is used today for a machine tool of the same size.

Enclosed Fan-Cooled Motors are Widely Used

The use of fully enclosed fan-cooled motors is steadily gaining. They are sealed tightly and designed to exclude dirt and moisture. Enclosed fan-cooled motors are applied to many classes of grinding machinery and have proved to be the solution of many grinder-motor difficulties. They are also a real economy in the foundry, where extremely fine dust is encountered.



Fan-cooled motors have given satisfactory service for such purposes as driving rotary-table sandblasts. One such motor has given uninterrupted service for three years, with no other attention than lubrication of the bearings. In the automobile industry, on a single application where a 3-horsepower enclosed fan-cooled motor was exposed to cast-iron dust, a saving of $56 was made in one year on motor maintenance cost.

Rapid Production in Single- and Multiple-Spindle Automatics

Equipping for the New Needs of Industry
Section 3

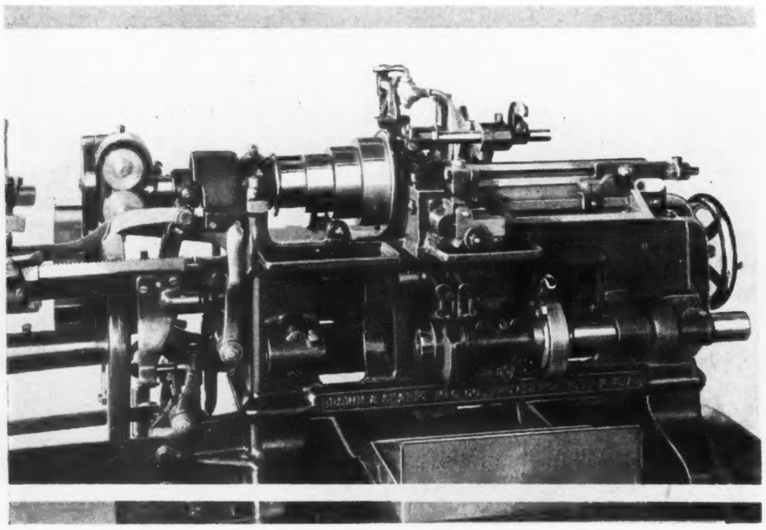


Fig. 1. Cutting off and Chamfering Steel Rods Over 11 Inches Long at the Rate of 900 an Hour on a Brown & Sharpe Automatic

IN automatic screw machines, the chief development during recent years has been in increased speed. Small automatic screw machines have been developed to a point where they will turn out many classes of work two or three times as rapidly as was formerly possible. This has been done largely by so arranging the design that several operations can be carried on simultaneously. Threading, forming, and cutting-off operations, for example, proceed at the same time, instead of each operation being completely finished before the next one begins. High-speed machines have also been developed which have made new records in production, especially on brass work. Along with higher spindle speeds, there has come an increase in the speed of the indexing movements. On some machines these are accomplished in half the former time.

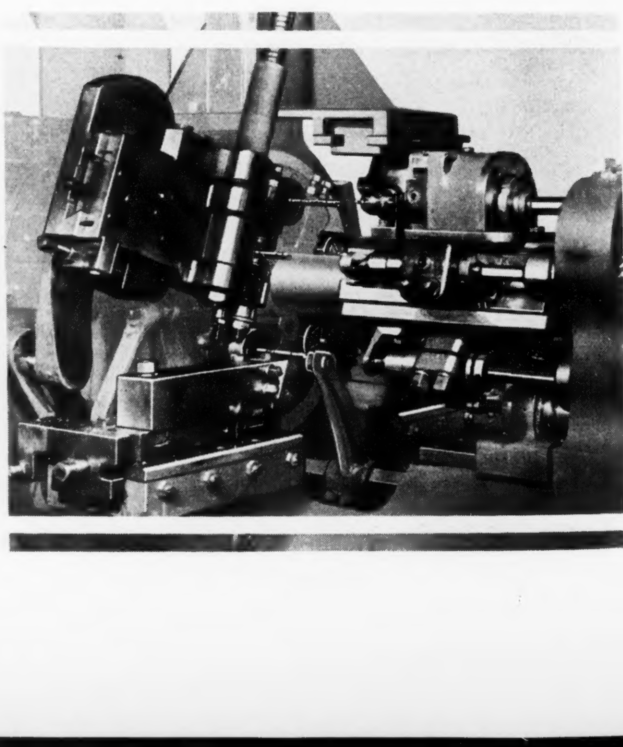
The improvements made are equally apparent in single-spindle and in multiple-spindle machines. One four-spindle automatic screw machine is now equipped with a lead-screw threading mechanism by means of which threading, tapping, reaming, chamfering, corner-rounding, and other tools can be used in the third and fourth positions. Accurate threads are insured with this mechanism, and it is especially advantageous in producing short threads, since these can be cut easily without damaging the first thread.

Another feature is an independent feed for each forming slide, which greatly increases the range of screw machine work, as different depths of cuts can be taken in each of the four spindle positions and different rates of feed can be used.

A five-spindle 7-inch automatic with hydraulically operated chucks has been developed for rapidly machining castings, forgings, etc., in first and second operations. The chucks can be adjusted to exert a slight yet positive grip on work that is easily distorted.

Rods from 1/8 to 1 1/8 inches in diameter, such as are used in typewriter

Fig. 2. National Acme Five-spindle Automatic Tooled to Produce Shafts for Windshield Cleaners at the Rate of 10 a Minute



and adding-machine frames, push-rods for overhead valve motors, and other rods that are ordinarily considered too long to be economically produced on automatic screw machines can be handled efficiently on machines of this kind when equipped as shown in Fig. 1. A roller feed eliminates multiple feedings, a timing mechanism locates the new bar in the proper relation to the tools for trimming and removing the waste end, and a rod magazine automatically places a new bar in position in six seconds.

The machine illustrated handles cold-rolled steel rods over 11 inches in length at a rate of 900 pieces an hour, cutting off and chamfering both ends. The same arrangement is available for larger machines, and can also be applied where the rods require turret operations.

Forming, Milling, Drilling, and Cutting Off 600 Small Shafts an Hour

The "paddle" shafts used in the "Trico" windshield cleaners are completely finished from 1/4-inch round, super-cut, screw stock on the five-spindle automatic screw machine shown in Fig. 2, at the rate of one shaft every six seconds.

Formerly automatic screw machines were used only for making the blank shafts, the milling and cross-drilling operations being performed at a second handling. The work is held within a maximum allowance of 0.002 inch between the turned shoulders, the thickness of the flats on the milled portion, the relative positions of the flats, the relation of the cross-drilled hole to the flat portion, and the concentricity of the drilled hole in the end of the shaft.

The work-spindle is stopped as it comes to the second position and does not start to rotate again until after it has been indexed from the third position. The special milling fixture in the second position is driven independently by a small motor through a flexible shaft. There are two sets of milling cutters which mill the two separate flats in the same plane. Two separate fixtures operate in the third position. A cross-drilling attachment is supported from the top slide and drills the cross-hole. The special milling or profiling attachment is mounted on the main tool-slide.

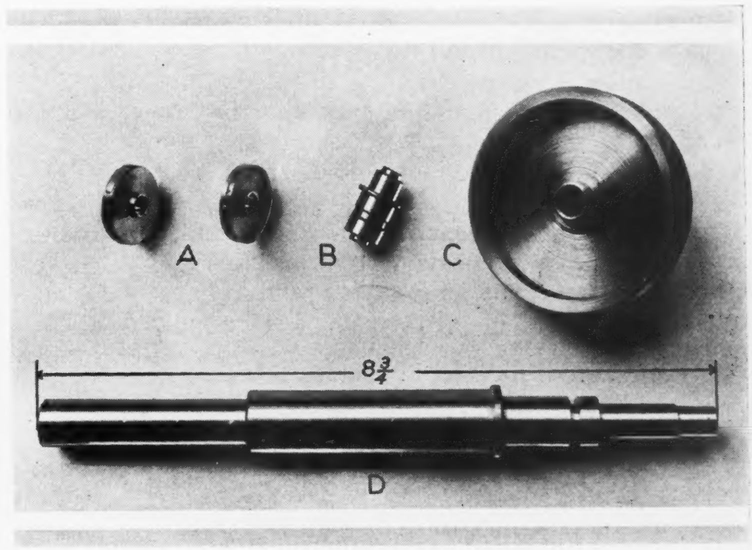
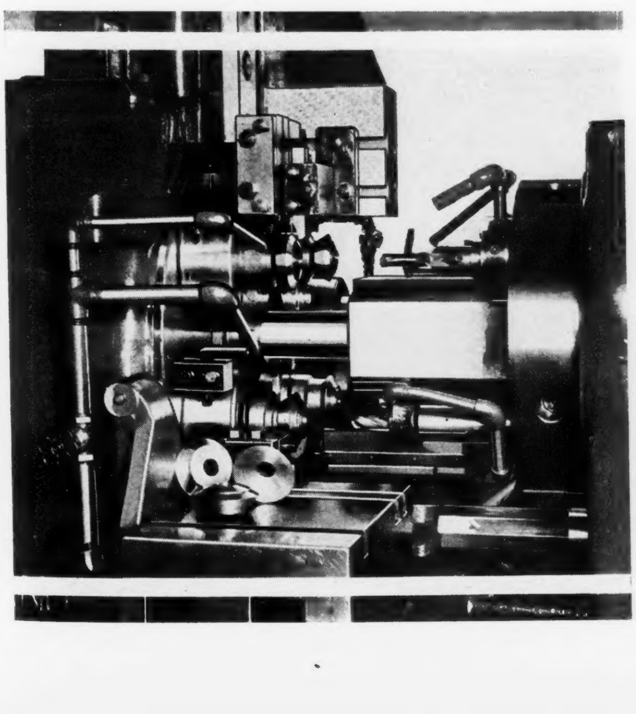


Fig. 3. Examples of Screw Machine Work Performed at Rapid Rates—Production (A), 645 an Hour; (B), 120 an Hour; (C), 28 an Hour; (D), 7 an Hour

Fig. 4. Four-spindle Cleveland Automatic Equipped for Drilling, Boring, Reaming, and Rough- and Finish-forming Gear Blanks at the Rate of 46 an Hour



Screw-Machine Production Records Obtained in a Large Manufacturing Plant

The following examples of automatic screw machine work performed in the plant of the National Cash Register Co., Dayton, Ohio, are indicative of the progress made in developing machines and equipment for the production of small screws, studs, and other small parts made from bar stock.

In one department, a small rivet, about 5/32 inch long, with a 3/16-inch chamfered head, two shoulders, and a cupped end, is accurately machined from 3/16-inch brass rod at the rate of 2880 pieces an hour.

In another case, a special shouldered and threaded flat-head screw about 15/32 inch long is formed, threaded, cut off, and slotted at the rate of 450 pieces an hour. This special screw is made from 3/8-inch cold-drawn steel.

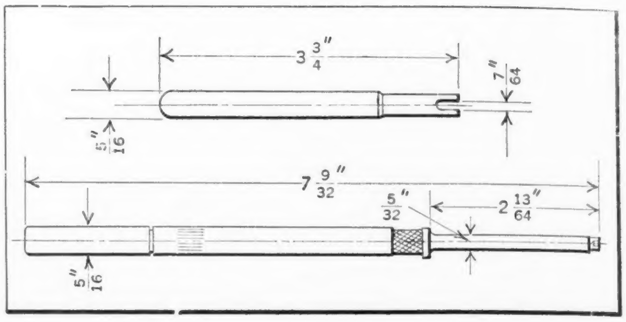


Fig. 5. Parts of the Type for which the Equipment Shown in Fig. 6 is Suitable

Other examples of automatic screw machine work performed in the same plant are shown in Fig. 3. At *A* is shown a brass counter wheel with characters rolled on the rim, made from 1.014-inch rod on a single-spindle machine at the rate of 645 pieces an hour. At *B* is shown a steel stud with a reamed hole, made from 5/8-inch cold-drawn steel on a five-spindle automatic at the rate of 120 an hour. The clutch shell at *C* is made from 2 7/8-inch cold-drawn steel on a multiple-spindle automatic at the rate of 28 an hour. The stud at *D* is made from 7/8-inch cold-drawn steel on a single-spindle automatic at the rate of 7 an hour.

Another interesting example of work performed on a five-spindle automatic screw machine is the knurling, forming, drilling, facing, and tapping of brass dry-battery nuts at the rate of 180 a minute.

Long Parts Produced by Automatic Screw Machines with Special Attachments

The variety of work handled on automatic screw machines, as well as the volume, has been greatly increased by improvements in the design of the machines, and in many cases by the application of special attachments. For example, the pieces shown in Fig. 5, which were too long to be handled on a machine with standard equipment, can now be produced on the automatic screw machine shown in Fig. 6, as a result of the increased capacity afforded by the "second feed attachment" at the left end of the machine. The part shown in the upper view, Fig. 5, is produced from free-cutting steel rod in six seconds, or at a continuous production rate of 480 pieces an hour, while the piece shown in the lower view is produced at the rate of 320 pieces an hour.

A small brass part requiring nine operations, which was produced in eight seconds in 1923, is now being produced in four seconds as a result of improved equipment and tool lay-outs.

Differential Gear Blanks Machined at Rapid Rate

Differential gear blanks are drilled, bored, reamed, and rough- and finish-formed from No. 3515 nickel-steel bar stock at the rate of 46 an hour on a 3 1/2-inch, four-spindle automatic, as shown in Fig. 4. An end-facing tool for shaving the radial surface is mounted on the rear of the square turret attachment. A tool on the top slide takes a semi-finish-facing cut on the radial surface. The cut-off tool is mounted on the rear of the top slide.

The examples of automatic screw machine performance recorded in this article indicate the remarkable advance that has been made in equipment of this kind. Production is achieved that only a few years ago would have been considered entirely impossible. And what is more, this production has been attained, not only without sacrifice of accuracy, but in many instances with a gain in this respect. Tolerances are being maintained on present machines in everyday production that were formerly possible only under the most favorable conditions, when extreme care and constant attention were

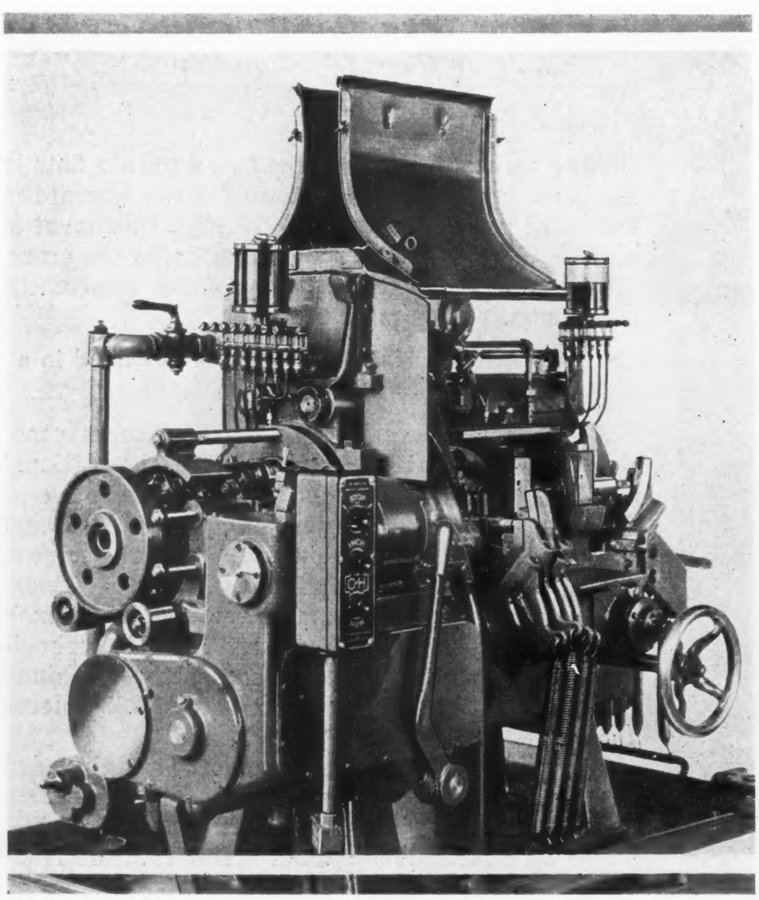


Fig. 6. Davenport Automatic Screw Machine with Attachment Designed for Machining Long Pieces — Parts Shown in Fig. 5 are Produced in from 6 to 10 Seconds

given to the work being performed.

In the development of machines to meet the needs of industry for high-speed production, especially of small parts, the manufacturers and designers of automatic machinery have more than kept pace with the general development in machine tool equipment. In this way, they have aided the manufacturers of consumer products to reduce their costs, which, in turn, has meant reduced prices, making the products available to a constantly increasing number of purchasers.

It is only necessary to point to such products as the radio or the vacuum sweeper as examples. A great number of parts are produced on automatic screw machines, which, if they were to be produced by any other means, would be so costly that neither radio sets nor vacuum sweepers would be available to practically every household, as they now are.

The radio and the vacuum sweeper are mentioned merely as examples. They are probably not even the most outstanding examples. Scores of other articles, both for domestic and industrial use, depend for their economical production upon automatic machines. In our present industrial era, when in spite of the increasing facilities for production, competition is keener than ever, the automatic machine is playing an increasingly important part, because engineers are constantly racking their brains to so design their products that more and more parts can be produced quickly and cheaply on machines of this type.

It has been said that we have practically reached the limit of high production by means of automatics. The same thing was probably said five years ago. Yet the developments in the last five years have entirely disproved that contention, and it is likely that future developments will disprove any statement to the effect that the utlimate goal has now been reached in productive capacity, even on such highly productive equipment as automatic screw machines and kindred equipment. Designers will still find a way to further progress.

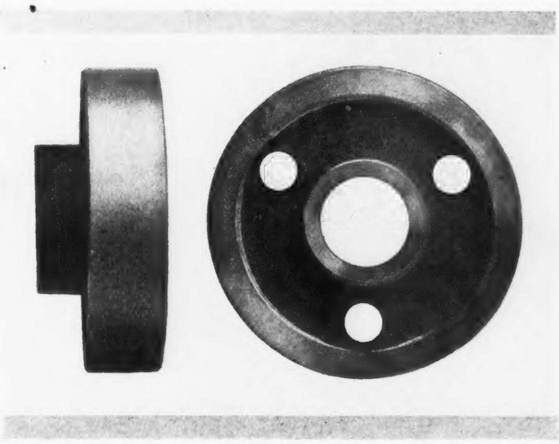
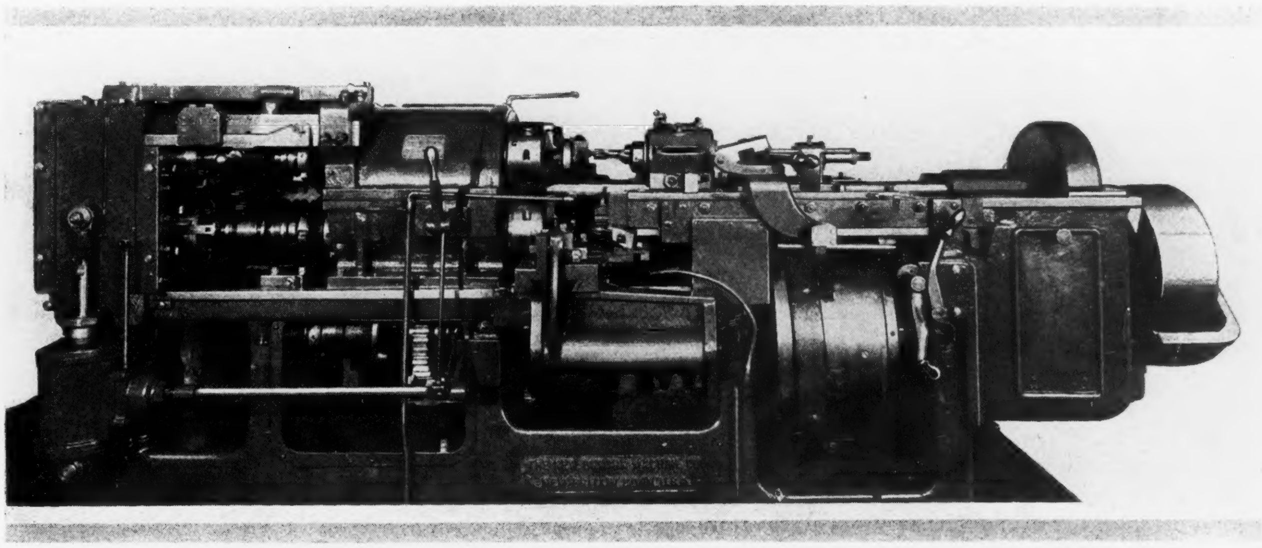


Fig. 7. Cast-iron Gear Blank, 4 1/2 Inches in Diameter, in which the Hole is Bored and Reamed, Outside Rough- and Finish-turned, and Hub and Rims Rough- and Finish-faced in the Machine Shown in Fig. 8

Fig. 8. New Britain Four-spindle New-Matic Chucking Machine in which the Gear Blanks Shown in Fig. 7 are Machined with Tungsten-carbide Tipped Turning and Facing Cutters at the Rate of 157 Pieces an Hour



New Power Transmission and Lubricating Methods Facilitate Operation

Equipping for the New Needs of Industry
Section 4

POWER transmitting equipment in general has been greatly improved within the last few years, from the standpoint both of operating efficiency and convenience of installation. New types of equipment have also been developed and new methods of lubrication have been devised to overcome many of the difficulties formerly experienced.

Belts constitute one of the basic means of power transmission. Considerable progress has been made within the last few years in the development and improvement of belt drives. The progress has been particularly marked in the case of short-center drives, such as are used to transmit power from electric motors to machines and lineshafts. These short-center drives are made in both flat and V-belt types.

Short-Center Belt Drives Are Now not only Practicable but Economical

In the case of short-center flat-belt drives, the tension is generally maintained by mounting the motor on a base fulcrumed in such a way that the combined weight of the motor and base acts on the belt. An adjustment is available for moving the motor along the base in order to obtain the correct lever arm to produce the required tension. In general, however, the base can be so designed that the motor used for the drive will produce the necessary tension in the belt without much adjustment.

A maximum tension of 300 pounds per square inch is recommended; and it is claimed that if this tension is maintained, flat belts will run with an efficiency of 95 per cent. Still greater efficiency has been obtained. Short-center flat-belt drives, with specially made endless flat leather belts, are regularly produced by one manufacturer in sizes from 1 to 50 horsepower. These drives have been developed to a point where they have shown an efficiency of 99 per cent—belt slip and creep less than 1 per cent.

Short-center V-belt drives designed to occupy the smallest possible floor space are made by one company for use on motor-driven machines. These drives can be used with pulley ratios as high as 7 to 1.

Within the last six years, over 100,000 multiple V-belt Texrope drives, aggregating more than 1,500,000 horsepower, have been applied to almost every form of industrial machinery for ratings ranging from 1/2 to 2000 horsepower.

Cog-belt drives consisting of specially designed V-belts and grooved pulleys are made in a complete range of sizes for practically any industrial application from 2 to 300 horsepower. The multiple and single-groove pulleys used with drives of this type are made in split and solid designs. The cog belts can also be used in standard V-grooved pulleys. The features of the cog belt are a high degree of flexibility and great gripping power, which permit the use of small pulleys and short center distances.

Belts Designed for High Speeds

High belt speeds, up to 7500 feet per minute, are permissible with "Tentacular" transmission belts. These belts consist of a single- or double-ply leather or fabric backing, to the pulley side of which are attached narrow strips of very soft pliable plastic leather having a high coefficient of friction. These strips run lengthwise and are fastened to the backing by hollow rivets that form depressions in the soft leather strips. In this construction, the backing or outer ply belt transmits the load without coming in contact with the pulley.

Means for Preventing Belt Slippage

A new method of preventing belt slippage consists of cementing a special canvas, known as "Duktex," around the periphery of the pulley by using a cement which is also applied lightly to the canvas covering about twice a month. It is claimed that a pulley surface that has been treated in this way can readily be gripped by leather, rubber, or woven belts.

Pulleys in which vacuum cups are used for obtaining a firm grip between the belt and the pulley are available as a commercial product. These pulleys have spherical-shaped recesses on the faces to aid in preventing belt slippage and to increase the efficiency of power transmission.

Up to a short time ago, manufacturers of rubber belts generally advised against the use of dressings for belts of this kind. A new belt dressing is now available containing no oil or grease and no chemicals that are harmful either to the rubber belts or to the pulleys. This dressing is non-inflammable and is effective for a long period of time after application. It is available in stick form.

Improvements in Chain and Link Belt Drives

Both cast malleable and steel drive chains have been improved through stronger materials and greater accuracy in casting or machining the links. In the case of steel chains, heat-treatments are applied to further increase the strength and wearing qualities of the improved steels employed. Greater care is being taken today to have the contour of the sprocket tooth designed correctly and machined accurately to fit the chain.

As a result of improvements in the chain and sprocket tooth contact surfaces, quieter and smoother operation is obtained. The development of accurate inspection equipment is largely responsible for the high degree of uniformity and interchangeability found in today's product. Chains of present design are able to carry much heavier loads than the older chains of corresponding weight.

Automatic adjustment of chain tension has been developed for use where accurate timing is essential. Chains have been designed with loose or swivel joints which will operate on sprockets located in two different planes. Bronze and stainless steel chains have been made for use in some industries where corrosion resistance is important. When the corrosive action is very mild, sufficient protection is obtained by mild galvanizing, tinning, sherardizing, cadmium-plating, chromium-plating, Parkerizing, etc.

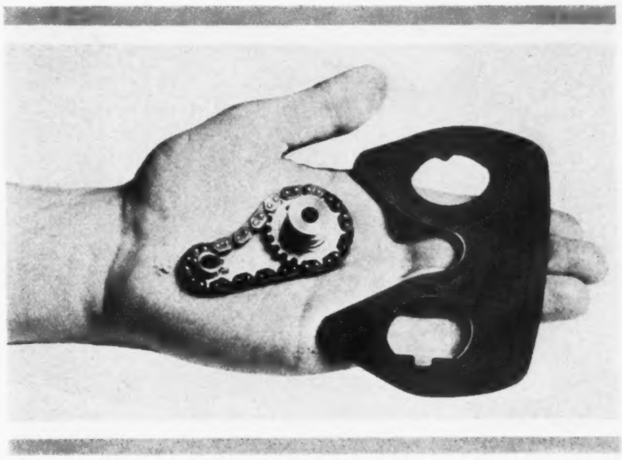


Fig. 1. Complete Morse Silent Chain Drive of 3/16-inch Pitch, Compared with Link from 3-inch Pitch Chain of Same Type

Fig. 1 shows how a 3/16-inch pitch silent chain drive consisting of two sprockets and a chain compares in size with a single link from a 3-inch pitch chain. The development of the tiny 3/16-inch pitch chain in 1925 resulted in the widespread application of small-pitch chain drives to moving picture projectors, sewing machines, adding machines, technical laboratory precision machines, etc.

Motorized Speed Reducers are Available in Many Types and Sizes

Rapid advance has been made in the development of motorized speed reducers—that is, speed reducers in which the motor is an integral part of the equipment. The outstanding features of these reducers are compactness and accurate alignment of the armature shaft with the low-speed shaft. Also, the appearance of the unit is greatly improved when the motor and speed reducer are built into one compact unit. These motorized units are made with three types of drives, namely, worm-gear; regular gear train with parallel shafts; and planetary gearing.

The worm-gear reduction units are available in several types, for operation in vertical, horizontal, and angular positions. One manufacturer makes these units in sizes from 1/30 to 10 horsepower and in speed ratios from 8 to 1 up to 72 to 1. A double unit of this type is available, which provides reduction ratios as high as 2760 to 1.

The parallel shaft motorized units are generally made with steel, spiral, or continuous herringbone type gears. They are also made with fiber gears for use where quietness of operation is an important consideration. The sizes range from 1/30 up to 40 horsepower, in standard designs, with speed ratios up to 6 to 1.

Still another type of parallel shaft unit consists of a geared motor with built-in speed-changing units having constant-mesh change-gears by means of which any one of four speeds can be obtained by shifting one lever while the motor is running at full speed and under load. These units are built with motors of from 1/2 to 15 horsepower and in two-, three- and four-speed types to give eight, twelve and sixteen different output speeds.

The standard ratings for a line of recently developed motors with planetary reduction gears built integral with the motors include polyphase motors from 3/4 to 75 horsepower; single-phase motors from 3/4 to 5 horsepower; and direct-current motors from 3/4 to 7 1/2 horsepower. The range of speeds covered by these motor units is from 13 to 600 revolutions per minute. Planetary-gear speed-reducer units are now made which are designed to replace the regular head on the shaft side of any standard motor from 1/6 to 75 horsepower. Speed ratios as high as 70 to 1 are obtained by units of this kind. The so-called planetary gearless adhesion drive for speed reducers is built in sizes up to 50 horsepower, and for ratios up to 10 to 1.

Speed Reducer Units Are Greatly Improved in Quality and Performance

Practically all the various sizes and types of speed reducers designed for use with belt, motor, or other type of drive have been improved within recent years. Many of these units are now built with gears and shafts of heat-treated alloy steels. The gears now generally used in these transmissions are not only machined more accurately,

but in many cases are of the helical and herringbone type.

Roller and ball bearings are being used more extensively and lubricating methods have been greatly improved. Vertical and horizontal speed reducers are made in types designed to be impervious to acid fumes, dust, or moisture. Units have been designed to eliminate any danger of oil leakage, even while the shafts are in a vertical position. Speed reducers of large sizes are being made regularly; one manufacturer, for example, makes regularly generated, continuous-tooth, herringbone-gear speed reducers for right-angle or straight-line drives in sizes from 1 to 1000 horsepower, and even larger, with ratios from 1 1/2 : 2 to 150 : 1.

An electro-hydraulic transmission is now available, which provides for any required change in speed from zero to maximum. Another type of variable-speed transmission consists of a variable-delivery rotary hydraulic pump connected with a hydraulic motor. The hydraulic pump may be driven by an electric motor, engine, or lineshaft. The delivery of fluid under pressure into the radial cylinders of the hydraulic motor causes its driving unit to revolve. This variable-speed transmission provides a full range of speeds from zero to maximum in either direction, without stopping the constant-speed drive to the hydraulic pump. This type of transmission is regularly made in sizes from 8 to 200 horsepower, and is adapted for machine tool drives and steel mill equipment.

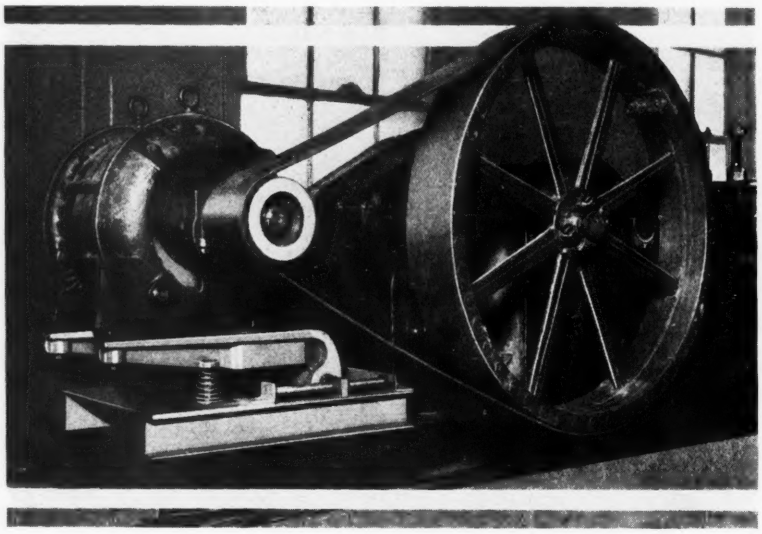


Fig. 2. Rockwood Drive Connecting 60-horsepower, 1200-revolutions-per-minute Motor with Hydraulic Pump. The Center Distance is 50 Inches and the Speed Reduction 6 to 1. Belt Slip is Less Than 1 Per Cent

Variable-Speed V-Belt Transmission

The speed of machines and conveyors can be accurately adjusted to meet varying conditions of operation by means of a variable-speed transmission consisting essentially of a V-belt which fits the V-shaped throat formed by conical disks. When the two disks are brought closer together, the V-belt runs nearer the peripheries of the disks. The effective working diameters of the disk pulleys can thus be varied by adjusting the positions of the disks through convenient controls. Any speed between the fastest and the slowest is obtainable with this arrangement. These transmissions are regularly built in sizes ranging from fractional to 125 horsepower, and with speed ratios from 2 to 1 up to 16 to 1.

A simplified type of variable-speed unit, with the adjustable-disk driving pulley mounted directly on the motor shaft, has recently been brought out in sizes from 1/8 to 7 1/2 horsepower. This equipment provides for accurate speed control for any ratio up to 3 to 1.

Eight speed changes with ratios up to 9 to 1 are available in a multi-speed transmission consisting essentially of a V-disk made of a composition and two grooved cones or sheaves made of steel. This transmission is made in sizes from 3/4 to 10 horsepower and is used for bench lathes, drilling machines, etc. The composition disk runs as an idler between the driving and driven cones. As the cone centers are fixed, they have a tendency to pull the disk between them, producing a wedging action that varies in direct proportion to the load. This action also prevents any change in the position of the idler disk while driving. Speed changes are easily made by a star-shaped knob.

Clutches and couplings of improved design have been developed for various purposes. The types and sizes now available cover almost every requirement of industry. One of the interesting developments is an automatic starting clutch designed to permit the driving motor or other prime mover to come up to speed without any load being imposed upon it. By an ingenious arrangement, the motor is brought up to speed in a few seconds before it actually grips and begins to transmit power to the equipment being driven. This clutch can be part of the driving member of a silent or roller chain, a flat belt, a multiple V-belt, or a gear drive, or it can be used as a coupling in direct-connected drives. These couplings are available in a range of sizes for transmitting from 0.1 to 122 horsepower.

A new magnetic control for multiple-disk friction clutches and brakes applied to power presses has recently been developed. This clutch uses the same friction disks and plates as a standard mechanically

operated clutch, but all operating wings and levers are eliminated. The pull of the magnet is transmitted directly to the moving plate of the clutch and no thrust is transmitted to any bearing. This control equipment provides full-automatic features and, in addition, when several operators are employed, safeguards all of them.

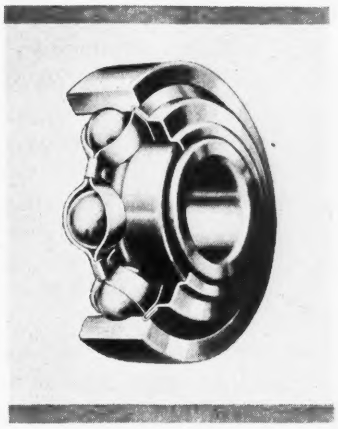


Fig. 3. New Departure Ball Bearing with Built-in Seal that Effectively Retains the Lubricant and Prevents Dust from Entering

Important Achievements in Ball Bearing Design

Improvements made in the design of ball bearings within the last two or three years have resulted in material benefits to the machinery builder. The range of bearing types and sizes has been extended so that ball bearings are now available for almost every conceivable service.

One of the most important new types developed during this period is the self-enclosed ball bearing, which not only incorporates a built-in seal, preventing the entrance of dirt and foreign matter, but also so efficiently retains the lubricant introduced at the time of manufacture that successful operation is often possible for several years without further lubrication. This type of bearing relieves the machine builder of the need for supplying and mounting many parts previously required for the enclosure of ball bearings.

In applications where metal chips are likely to enter the bearings, it has been common practice to use stamped metal slingers or washers as a means of protection. Bearings are now produced with built-in steel shields on either one or both sides, which are much more efficient than separate shields. The integral shields do not impose any difficult mounting conditions other than those encountered with ordinary non-shielded bearings, and the shielded bearings may therefore be applied without having to make any changes.

Still another bearing modification which has simplified and reduced the cost of bearing installation for the machinery manufacturer is the "snap-ring" or "shoulder-ring" bearing. This type of bearing does not require the machining of an integral shoulder in the housing for axle location, the latter being accomplished by the shoulder ring fitted to the outside of the bearing. By means of this bearing it is possible, in many instances, for the machine builder to achieve better alignment of parts, and at a lower cost for machining operations, by boring the bearing and housings straight through at one set-up. Various bearing makers supply the shoulder-ring bearings in either shielded or non-shielded types, thus meeting a wide range of mounting conditions.

Single-Row Angular-Contact Ball Bearing of High Precision

The development of ball bearings for machine tool spindles led to the design of a single-row angular contact type of ball bearing, made to much closer limits of accuracy than were formerly thought commercially practicable, with the result that heavy thrust or combined loads are carried with a minimum amount of deflection, and precision spindles are held within closer limits than had previously been possible. Hand in hand with this type of bearing has come preloading, which has been developed to the point where shop mechanics of average skill can obtain the rigidity and accuracy of which these bearings are capable with almost mathematical uniformity and certainty.

The benefits of preloading have been scientifically utilized for certain types of angular-contact double-row ball bearings, with the result that shaft centering is better maintained; axial loads from either direction are carried with much less deflection; and misaligning loads may, in many instances, be carried by a single bearing. This results in maximum economy, for it prevents the use of bearings that are either too small or too large for the service desired.

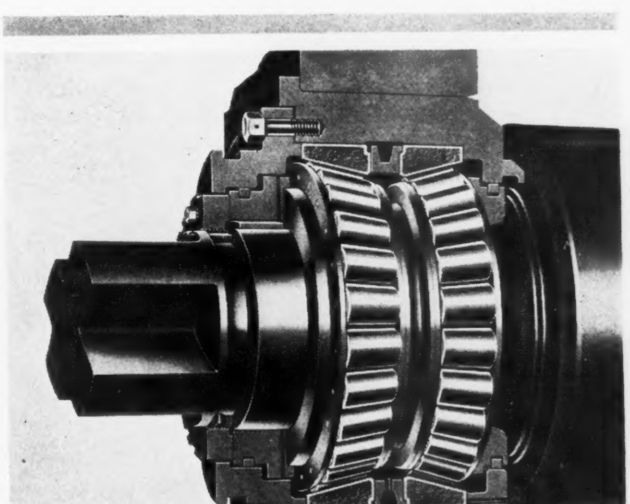


Fig. 4. Roll-neck Bearing of Large Capacity for Steel Mill Developed by the Timken Roller Bearing Co.

The saving in power consumption resulting from the use of ball bearings is well illustrated by the experience of a company manufac-

turing looms. This company installed 324 ball-bearing hanger boxes on loom drive shafts, which reduced the power consumption 10 per cent. Careful test runs have been made, and, as a result, it has been determined that the total yearly saving from the use of these boxes is close to $900. On this basis, the installation will pay for itself in three years.

Developments in Roller Bearing Applications

Remarkable progress has been made within the last few years in the development and application of roller bearings. Many new roller bearings have been designed to meet special requirements. These developments cover a broad field of application, ranging from the comparatively small sizes recently designed for the rocker arms of airplane engines to the mammoth roller bearings developed for steel-mill roll-necks, one of which is shown in Fig. 4.

Among the recently designed bearings is a roller thrust bearing having an outside diameter of 12 1/2 inches and an inside diameter of 6 inches which has a capacity for taking a thrust of 97,000 pounds at a speed of 500 revolutions per minute.

Roller Bearings for Locomotives

Neither the speed of operation nor the size of the bearing required now places any obstacles in the way of the use of roller bearings. The roller-bearing equipped locomotive weighing 417,500 pounds, which recently completed more than 100,000 miles of service without any bearing troubles, testifies to the progress made in applying roller bearings to heavy service, where they are subjected to all kinds of weather and temperature conditions. One of the advantages of equipping all axles of this locomotive with roller bearings shows itself in the substantial saving that has been made by not having to repair or replace the bearings. In addition, indirect savings have resulted through longer life of other parts. Lower maintenance costs are also recorded, due to the fact that no attention has to be paid to lubrication for periods of several months.

The fact that the Pennsylvania Railroad is providing its 150 new locomotives for service between New York and Washington with roller bearings is an indication of the practicability of such installations. Tapered roller bearings will be used for all the engine trucks and the driver wheels. Formerly electric locomotives, as well as steam locomotives, have been equipped with plain bearings.

A recent development in roller bearing design is the flanged-cup type of roller bearing which is especially adapted for use in the machine tool field, particularly on milling-machine spindles and machine tool gear-boxes. This type of bearing has a flange or shoulder on the outer end of the cup which seats against the face of the frame at the end of the hole in which the bearing is fitted. Thus the flange provides a simplified means of positively positioning the bearing cup.

Cageless tapered roller bearings are now made in all S A E sizes and are interchangeable with other types of anti-friction bearings. Positive roll alignment is obtained by the use of a double-ribbed back plate at the big end of the rolls. By eliminating the cage, from 20 to 50 per cent more rolls can be used. It is claimed that the high-speed and load-carrying capacities of these bearings make them particularly adapted for use in the machine tool industry and other industries having similar requirements.

That anti-friction bearings are gaining a position of importance in the machine tool field is indicated by the fact that a very large planer, recently built by a leading planer manufacturer, has all the gears, shafts, and clutches supported by anti-friction bearings, there being a total of 407 ball and roller bearings in the machine.

Improvements in Lubricating Methods and Equipment

The problems involved in providing efficient lubrication for bearings and surfaces in frictional contact have been carefully studied by designers and mechanical engineers during the last few years, and as a result, many new and highly efficient lubricating systems have been developed. Hand as well as mechanically operated lubricators have been greatly improved. New types of bearings designed to retain the lubricant more efficiently have appeared on the market. The so-called "oilless" bearings have been further developed.

New Means for Testing Lubricating and Wearing Qualities of Oils

Until recently there have been practically no means of obtaining accurate information, except with complicated laboratory apparatus, on the load-carrying capacity of lubricants, the measurement of friction, and the wear characteristics of any kind of material. A lubricant and wear tester has been developed especially for the use of manufacturers, buyers, and users of lubricants that will perform all three of these functions inexpensively. It was designed primarily to test the load-carrying capacity or film strength of lubricants. It is useful for checking a new lubricant in order to make sure that it is in accordance with specifications.

Multiple-Oiler Lubricator Systems

Multiple-oiler lubrication systems are made in both automatic and hand-operated types. In one of the hand-operated types, a single pressure on the pump lever forces oil through the tubing of the distribution system to oil-measuring devices. These, in turn, accurately measure and deliver predetermined amounts of lubricant under high pressure to the individual points to be lubricated. Either light or heavy oil can be pumped without adjustments. In normal operation, this device delivers oil under a pressure of about 500 pounds per square inch.

Some of the automatic multiple oilers designed for application to high-speed production machinery lubricate any number of bearings at intervals of

fifteen, thirty, forty-five, or sixty minutes, three hours, or any other intervals desired. These oilers can be operated either mechanically or by electric means. Mechanically operated oilers are actuated by a moving part of the machine being oiled. In cases where only three or four oilings per day are required, the oilers can be hand-operated.

Lubricating System Controlled by Temperature Changes

A novel automatic oiling system for industrial machinery operates electrically without a pump or other moving parts. It consists of an oil tank equipped with a heater unit which is separated from direct contact with the oil. When the machine to be lubricated is started, the electric heater is automatically turned on, the temperature of the oil is raised, and the expansion due to the increase in temperature forces the oil from the tank into the bearings; a metering device controls the flow of oil. Proper provisions are made for automatically filling the tank from a central supply or reservoir.

Another interesting type of automatic lubricator depends for its operation upon the expansion and contraction of air caused by temperature changes of the oil film in the shaft being lubricated. This lubricator is of air-tight construction; and after oil has been put in it, a cap is screwed down air-tight. The lubricator is filled with oil to only three-quarters of its capacity, an air space being maintained above the oil at all times.

Any slight increase in the temperature of the oil film around the bearing is transmitted through the lubricator to the air space, causing the air to expand. This creates a pressure on the oil, and automatically forces a certain amount of oil into the bearing, which results in decreasing the temperature of the oil film in the bearing. This, in turn, reduces the temperature of the lubricator and of the air, causing the air to contract and automatically stop the flow of oil.

Developments in Oilless Bearings

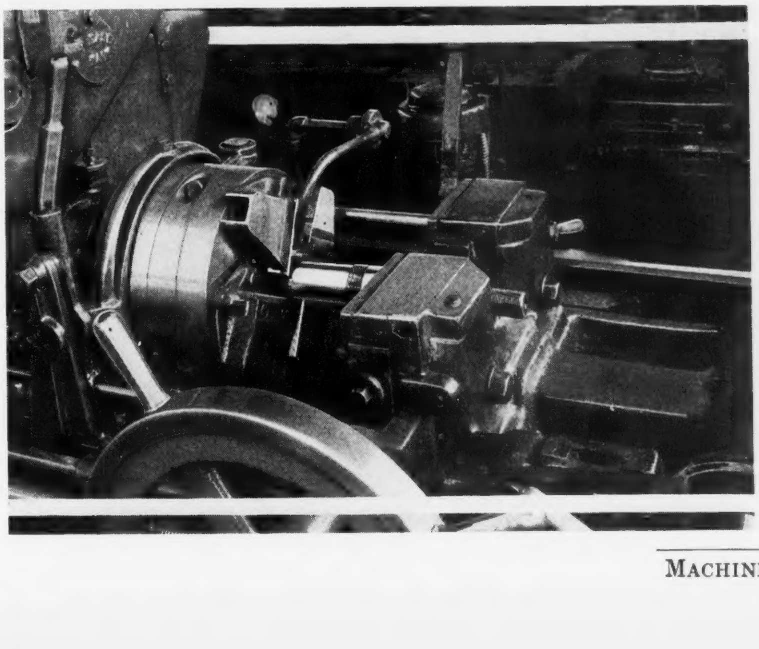
Various means have been developed to meet the demands for so-called "oilless" bearings. Among recent innovations are bronze bearings having spiral grooves filled with graphite. This type of bearing is designed especially for sliding or oscillating vertical and horizontal motions, as well as for full rotation of shafts at speeds up to 2500 revolutions per minute. The graphite lubricant functions satisfactorily at temperatures up to 1000 degrees F., so that the bearings can be used in drying or enamel baking ovens and similar installations.

Cast phosphor-bronze bushings and rolled sheet-metal bushings, both having dovetailed grooves impregnated with graphite, are also available. This type of bushing has been tested in a fractional horsepower motor run at 17,500 revolutions per minute continuously for 600 hours. At the end of this time, the wear on the bushing, as well as on the shaft, was found to be negligible.

Threading Automobile Axle Shafts in 20 Seconds

Automobile and truck axle shafts made of S A E 3140 steel, heat-treated to a Brinell hardness of 315 to 341, are being accurately and rapidly threaded at the plant of the Automotive Gear Works, Inc., Richmond, Ind., on 1 1/2- and 2 1/2-inch Landis threading machines. The threads are held to a Class 3 fit, or better, and concentric within close limits. The toughness of the material and the fact that many of the threads run close to a shoulder, necessitating the use of short throat chasers, makes this threading operation more difficult.

The illustration shows a close-up view of a 2 1/2-inch threading machine equipped for cutting the large-diameter threads on a truck axle shaft. The 3/4-inch long, 2.127-inch diameter, 16-pitch thread is cut in 20 seconds, the chasers producing 150 of these threads between grinds. The 1 1/4-inch diameter, 12 pitch, 1 9/32-inch long thread on the small end of the shaft, which runs within 3/16 inch of a shoulder, is cut in 12 seconds, 275 threads being produced between grinds.



Cutting Threads on a Truck Axle Shaft in a Landis Machine

Planers and Shapers Have Kept Step with Mechanical Progress

Equipping for the New Needs of Industry
Section 5

IN planers, noteworthy advances have been made in ease of operation, in rapidity of clamping, and in the stepping up of the speed ranges. Welded beds have been experimented with, and at least one large planer has been built with both bed and cross-rails welded.

Improvements in cutting tools have resulted in the design of planers with a minimum speed of 30 feet per minute, a maximum speed of 200 feet per minute, and a return speed of up to 210 feet per minute. Constant-voltage electric-motor drives are used on machines built for these speeds.

Large Planers Recently Constructed

Several very large planers have recently been built. One of these takes work up to 12 feet wide, 10 feet high, and 30 feet long. This planer has a weight of approximately 250 tons, yet all the movements are controlled by the operator from a single point. The rail clamp is controlled by a single button, which automatically unclamps the rail, raises or lowers it, and reclamps it. Rail-heads and side-heads are similarly controlled, both as regards traverse and feed, and there is independent feed for each of the four heads, as well as a 45-degree power angular feed of the side-head tools.

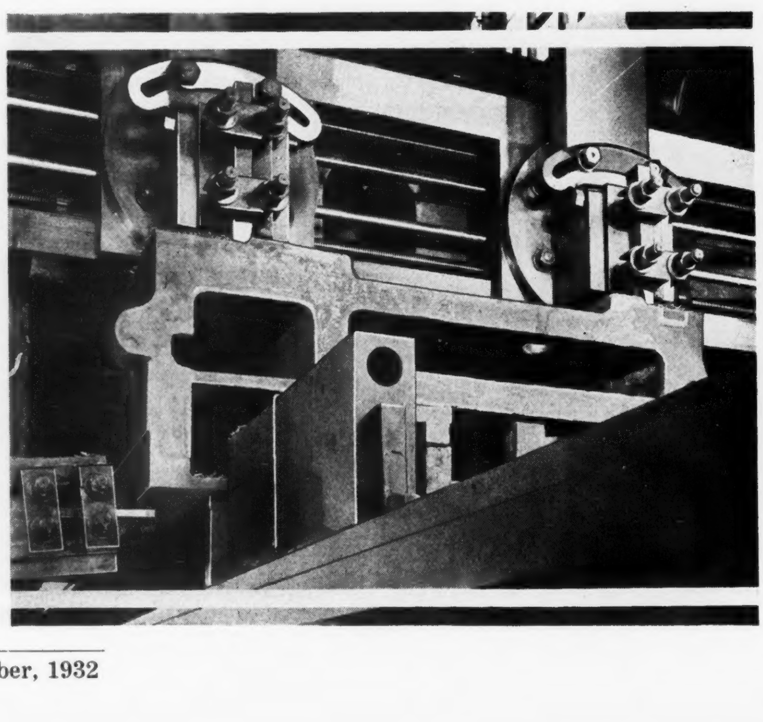
Several very large open-side planers have also been constructed. One of these machines has a capacity of 8 feet beneath the rail, and the left-hand head can plane down the side of castings over 10 feet wide. In spite of the size of the machine, its operation also is completely controlled from a single position, all heads being operated through electric push-buttons. A pendent switch is also supplied. The rail is clamped to the uprights by means of a motor, operated through a push-button. Power for raising and lowering the rail is provided by another motor, while the table movement is driven through a main motor. The approximate weight of this machine is 120 tons.

Some Large Planers in Operation

A huge planer is shown in operation in Fig. 2. Two rows of press frames are shown set up on a planer, 12 feet wide, in the shops of the Niagara Machine & Tool Works, Buffalo, N. Y. Both the bed and bearing-cap surfaces of these press frames are machined at one setting, it simply being necessary, after having planed the bed surfaces, to swivel the planer heads for machining the bearing-cap pads.

Two horizontal boring-machine beds are planed in one operation with the planer set-up shown in Fig. 3 at the plant of the Giddings & Lewis Machine Tool Co., Fond du Lac, Wis. The time required to machine the two beds with this equipment is 15 hours; the same work required 22 hours when performed on the open-side planer previously used. Two horizontal boring-machine

Fig. 1. Two Rail-heads and One Side-head of a 120-inch Sellers Planer Planing an Upright for a 12-foot Vertical Boring Mill, Using a Speed of 40 Feet per Minute, a Feed of 1/8 Inch, and a Cutting Depth of 3/4 Inch



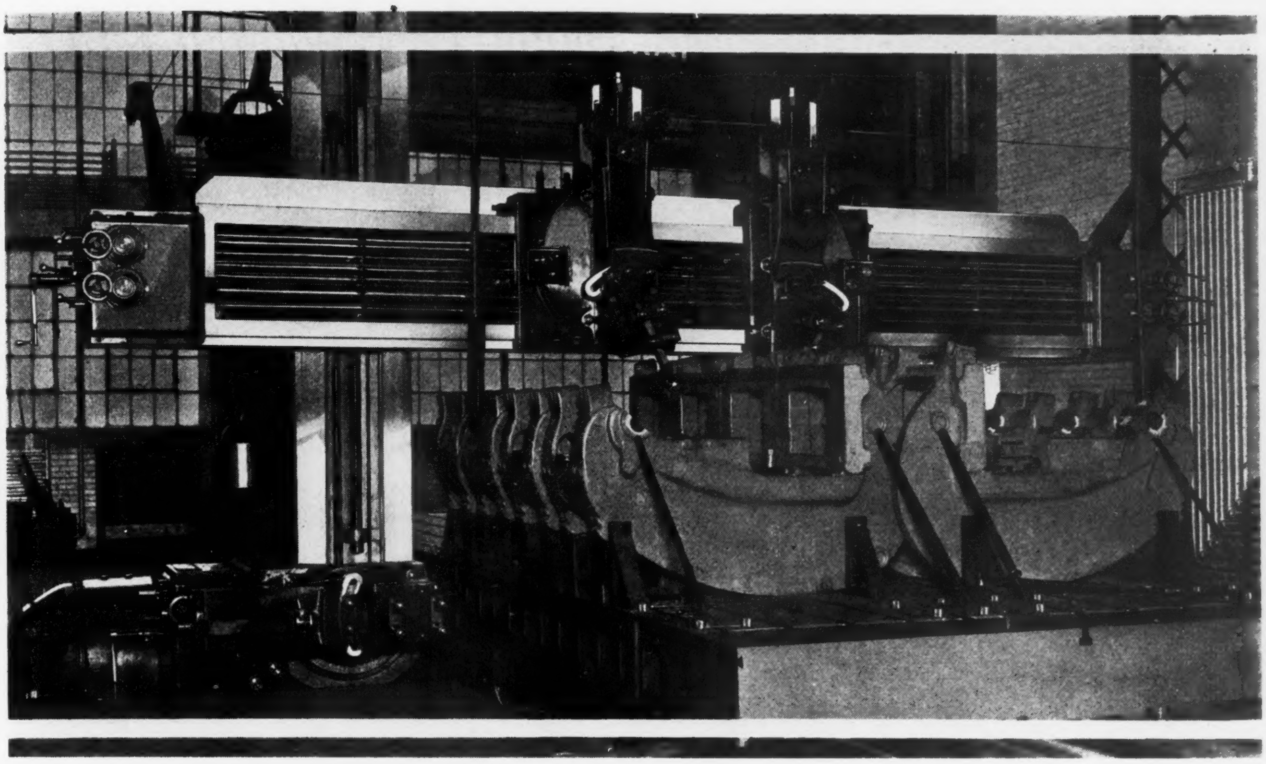


Fig. 2. A Gray Planer, 12 Feet Wide, Machining the Bed and Bearing-cap Surfaces of Two Rows of Press Frames at One Setting

Fig. 3. Planing Two Beds of Horizontal Boring Machines on a Cincinnati Planer. Time Reduced from 22 to 15 Hours

columns are also planed in a similar set-up in 20 hours, whereas the old machine took from 25 to 27 hours.

Automatic Tool Lifters for Carbide Cutting Tools

One of the important changes in planer design, brought about by the use of the tungsten-carbide cutting alloys is the incorporation of pneumatic tool-lifters to raise the tools clear of the work on the return stroke of the table. These lifters have been applied to one type of open-side planer. They can be used simultaneously on all the heads or on any one head.

A rapid-production rotary planer has been built with a hydraulic carriage traverse. The feeding arrangement provides for a very great range of feeds. A feed selector can be set to make any two feeds within the range of the machine instantly available. This feature is particularly advantageous when thick and thin sections are encountered, as in the machining of heavy structural members. The high-speed steel tools are arranged in a circle in the rotary cutter-head mounted on the horizontal spindle. Rapid traverse of the carriage, both forward and backward, is provided, and there are automatic stops at each end of the traverse, that may be adjusted to suit. The machine is self-contained, and the entire machine may be mounted on a circular base if desired.

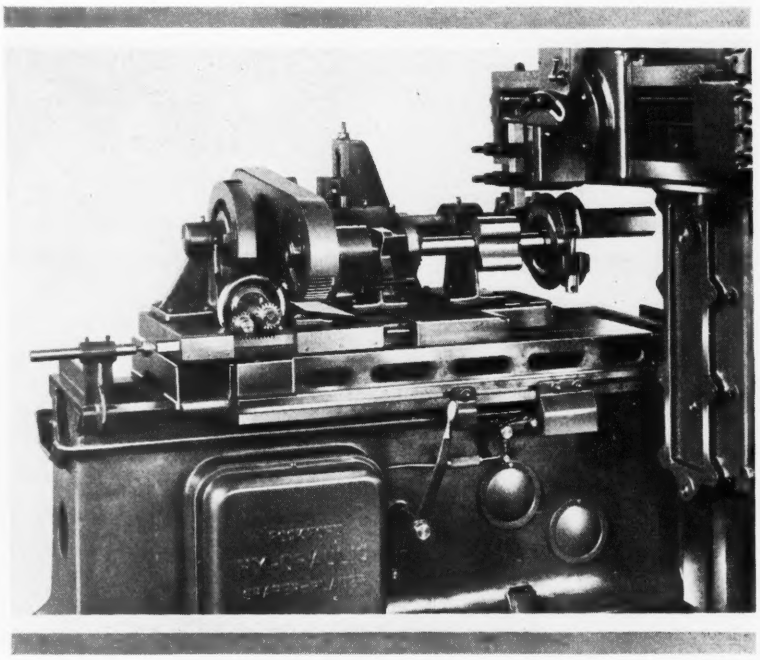


Fig. 4. Pump Rotors Machined on a Rockford Hydraulic Shaper-planer at the Plant of the Waterous Co., St. Paul, Minn., in Slightly Less than Two Hours

Hydraulic Power for Shapers

Hydraulic power has been applied for driving the ram and feeding the table of shapers. The use of hydraulic power insures a uniform cutting speed and cutting pressure from the beginning of each cut to the end. Smoothness of control is one of the features of this drive and chatter marks are more readily eliminated. The reversals of the ram are smoother and are obtained rapidly without shock. Any number of ram strokes is obtainable up to 150 per minute. The return ram speed may be selected between a maximum ratio with the cutting speed of 3.73 to 1 and a minimum ratio of 1.81 to 1.

Some Developments in Inspection Methods

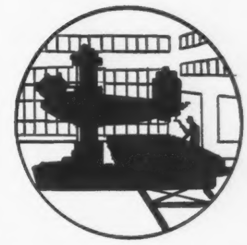
The use of optical projectors for inspection purposes has rapidly increased. There are now hundreds of applications throughout industry where these projectors are used daily for inspecting screw threads, gear-tooth forms, form cutters, and gages. Their application, however, is broadening out into the production field, as distinguished from the toolmaking and laboratory field.

As an example may be mentioned automotive poppet valves which have always presented a serious gaging problem, because of the fact that they are manufactured in large quantities and at the same time must be held to precision limits. The diameter of the stem, the angle of the seat, and the concentricity of the seat with the stem are important measurements that must be carefully inspected; so also are the over-all length and the recess near the end of the stem. Former methods for inspecting all these dimensions consumed much time and did not always give positive assurance of accuracy. Visual inspection by means of an optical projector has solved this problem and introduced a measure of rapidity, convenience, and accuracy that was formerly unattainable.

Numerous other optical inspection and measuring devices for use in regular shop work have also been developed. Microscopes are available that are especially adapted for examining cutting tools and machine parts for wear, for studying metal surfaces for tool marks or blow-holes, and for making regular routine microscopic inspections.

Accuracy to one hundred-thousandth of an inch is claimed for an electric gage recently developed. The gage does not depend upon human judgment. Rapid gaging of parts is possible—the gaging signals flash instantly. The tolerances to which this gage can be set range from 0.00002 to 0.002 inch.

Advances in Drilling, Boring, Honing and Tapping Machines



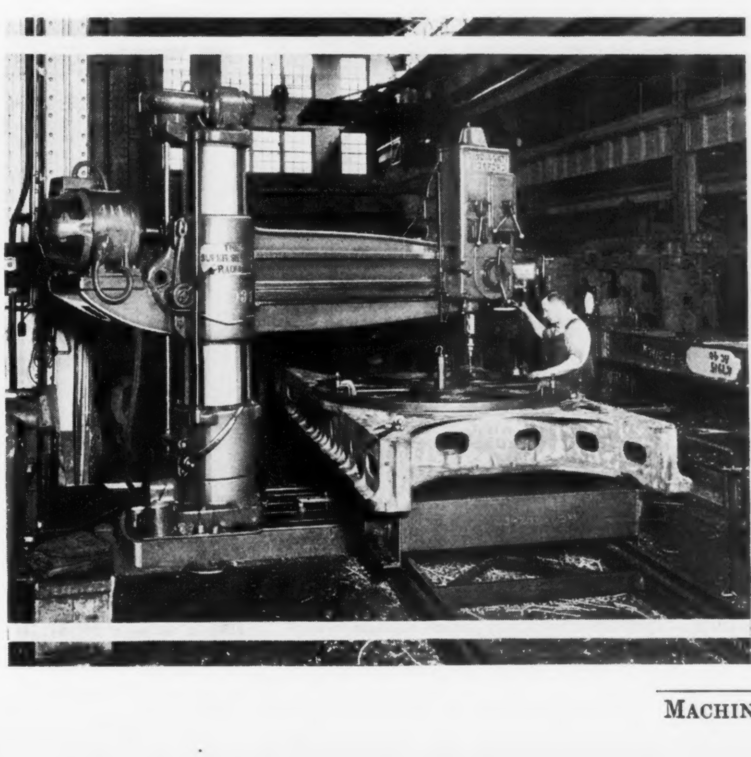
Equipping for the New Needs of Industry
Section 6

THE development that has taken place in other types of machine tools has been fully equalled in the group of machines used for drilling and boring, and for other operations performed on what might be termed "internal" surfaces. The radial drill is only one of the outstanding examples of this development. The modern radial has a tremendous power capacity, often in excess of present requirements. For example, some radial drills provided with 10-horsepower motors have spindles and gear-boxes that could easily transmit 20 horsepower if required. On account of the increased rigidity in the newer designs of drilling machines of all types, the limits of accuracy in machining ordinary commercial work can be set much closer than formerly; generally, about one-half the limits previously necessary are satisfactory.

The job illustrated in Fig. 1 consists of drilling 72 holes ranging from 3/4 to 1 3/8 inches in diameter in a 6000-pound casting. The limits of accuracy required on this job are 0.003 inch on the diameter and 0.005 inch on the center distances. The machining time of 4 1/2 hours represents a 22 per cent reduction over the time required by the radial drill that was previously employed.

In another plant, a radial drilling machine has cut the time required for drilling operations on a large steel casting from 113 to 9 hours. In still another plant, one machine of the same type drills in 9 man-hours work that formerly required two machines and 14 man-hours. In this case, 90 holes ranging from 1/2 to 3 1/2 inches in diameter and from 3 1/2 to 6 1/4 inches deep are drilled or bored, and most of them are reamed or tapped.

Fig. 1. Cincinnati-Bickford Radial Drilling Machine Finishing 72 Holes in a 6000-pound Casting in 4 1/2 Hours



In addition to the improvements made in standard drilling machines, a great many semi-special machines have been developed for drilling and boring, especially for the automobile industry. For example, boring machines with the spindles inclined for rough-boring, finish-boring, reaming, and counterboring cylinder castings having eight, twelve, or sixteen bores have greatly reduced the time required for such work. Machines of large capacity are available, it being possible to handle cylinder castings weighing over 500 pounds each.

Hydraulically operated machines have been developed for the precision boring of automobile pistons, connecting-rods, and similar work. Both rough- and finish-boring can be done at a single loading of the work and by the use of one work-fixture. Three pistons are simultaneously rough- and finish-bored.

The growing demand for accuracy in the machining of tappet valve holes and seats in automobile cylinder blocks has resulted in the use of rail-type drilling machines provided with multiple tools. These machines have twenty-four spindles, so that two cylinder blocks can be operated on at the same time. Two tools are mounted on each spindle. In addition to insuring concentricity of the surfaces within close limits, the use of multiple tools increases production.

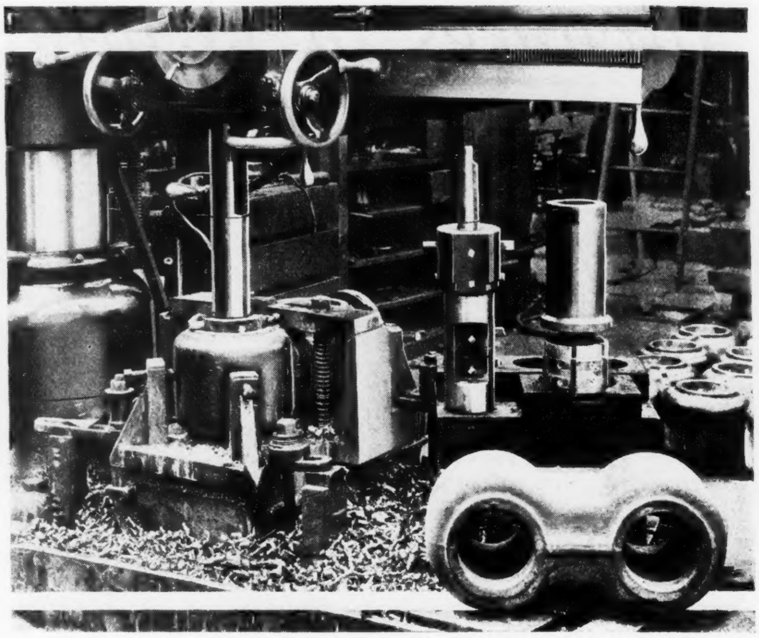


Fig. 2. An American Tool Works 4-foot Radial Drill Rough- and Finish- boring and End-facing Two 16-inch Holes in a Heavy Casting in 57 Minutes

A horizontal hydraulic drilling machine has been developed for drilling the camshaft holes in automobile cylinder blocks. Two horizontal sliding heads, each having four spindles, are mounted on a one-piece bed. This machine is fully automatic, including the indexing of a trunnion fixture and the clamping and releasing of the work-pieces. Thus it is only necessary for the operator to slide the pieces in and out of the fixture.

A combination drilling, reaming, counterboring, and tapping machine has been designed especially for finishing all the holes in steering-gear cases. The holes vary in size and location and some are at right angles to others. The operator merely loads and unloads the parts without starting or stopping any of the units, which operate automatically.

A vertical drilling machine has been developed which differs from the majority of machines of this kind in that the work is fed to and from the drill instead of the spindle being moved to and from the work. This is done by raising and lowering the table by means of a foot-treadle or hand-lever. This machine is adapted for accurate jig drilling. It has a capacity for drilling holes up to 1/2 inch.

Castings requiring a large number of drilling, reaming, and tapping operations can be handled at high production rates on the continuous type drilling machine shown in Fig. 4. Machines of this type are made up of standard units and are supplied with two or more spindles, according to requirements, equally spaced around the table, which is indexed hydraulically.

The set-up illustrated performs a total of seventy-seven operations on a cast-iron pump body. For this work, the machine is equipped with one horizontal and four vertical units, making a total of five work stations and one loading station. All units and the hydraulically controlled rotary table are under the control of a single foot-pedal.

The first indexing operation carries the work under the first station to the left, where twenty-nine holes are drilled. At the second station, eight more holes are drilled, while at the third station, reaming operations are performed on eight holes. At the fourth station, twenty-eight holes are tapped and at the fifth, four holes are drilled by the horizontal unit. After these operations are completed, a similar set-up is employed for performing a total of thirty-nine operations on the opposite side of the pump body. The production in each case is 84 pieces per hour.

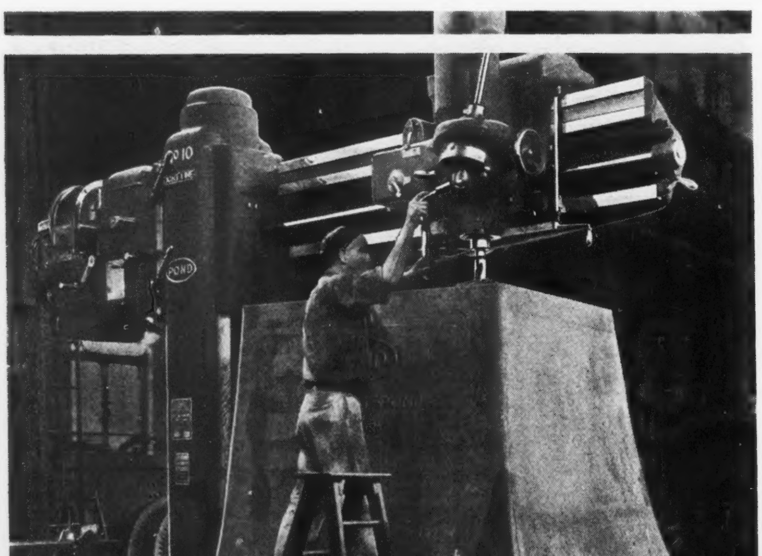


Fig. 3. A Niles Radial Drilling Machine Drilling a 2 1/2-inch Hole in the 17,000-pound Tailstock Base for a 168-inch Swing Engine Lathe. This Lathe, for the Ford Plant at River Rouge, is One of the Largest Lathes Ever Built

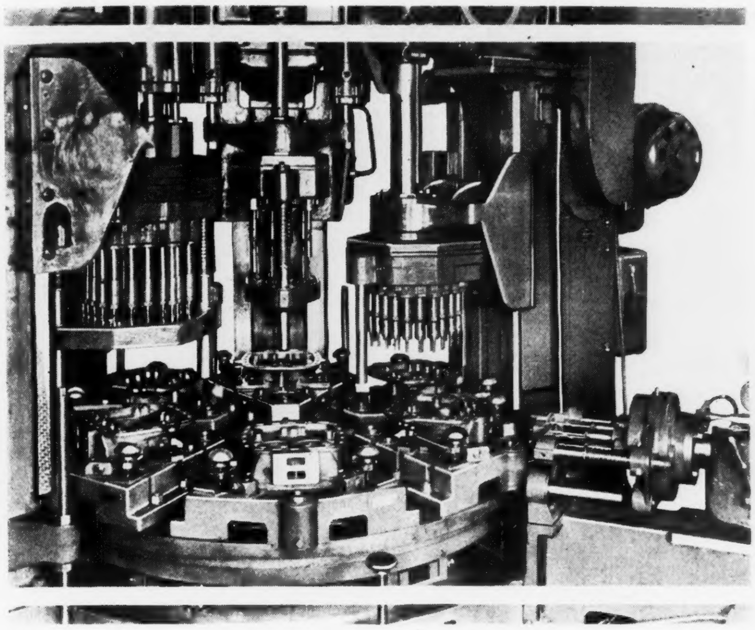


Fig. 4. A Barnes Drill Co.'s Continuous Drilling Machine Equipped for Performing a Total of 77 Drilling, Reaming, and Tapping Operations on Cast-iron Pump Bodies. Output, 84 an Hour

Liners for Diesel engines, in a number of different sizes, are bored and reamed on the hydraulically fed machine shown in Fig. 5. The special fixture is arranged to accommodate liners having bores 6 to 9 inches in diameter, and lengths of from 17 1/2 to 23 3/8 inches. The liners are first rough-bored and then transferred to a lathe where the rough-machined bores are located on an arbor while the ends are being turned on the outside. The liners are then brought back to the boring machine for the final boring and reaming.

For the first rough-boring operation, the pieces are chucked in cones, the lower cone being stationary, while the upper cone has a vertical clamping movement obtained by using two hydraulic cylinders, one on each side of the machine. For the second boring and the reaming operation, the cones are removed from the fixture and replaced by rings that fit over the previously turned ends.

Drilling and Counterboring 280 Tractor Track-Links an Hour

Forged-steel tractor track-links requiring rather unusual drilling and counterboring operations are handled at a production rate of approximately 280 pieces per hour on the vertical multiple-spindle drilling machine shown in Fig. 7. This includes four different pieces, so that actually 70 pieces each of four different designs are drilled and counterbored per hour. The machine is equipped with Oilgear feed. The slide carries a fixed-center gear-driven head, equipped with sixteen spindles.

The fixture holds eight parts (four right-hand and four left-hand) in each of three positions, and is mounted on a 44-inch rotating table which is indexed by hand. The operations are as follows: Position 1: Unload four pieces, change position of remaining four pieces, and load four new pieces. Position 2: Counterbore one large hole in each of the four parts and drill two 21/32-inch holes in two parts. Position 3: Finish-counterbore one large hole in each of the four parts and drill two 21/32-inch holes in each of the four parts.

Machines for Precision Boring

For the boring of accurately sized concentric holes, special machines have been developed, using either diamonds or tungsten-carbide tools. The spindles of such machines run at a speed of upward of 5000 revolutions per minute. As an example of what can be done in a machine of this kind may be mentioned the boring of a bronze bushing to a diameter of 13/16 inch for a depth of 1 3/8 inches, with a feed of 0.0006 inch per revolution and a depth of cut of 0.010 inch. This hole was bored in 35 seconds with a tolerance of 0.0007 inch.

A wide range of parts, including connecting-

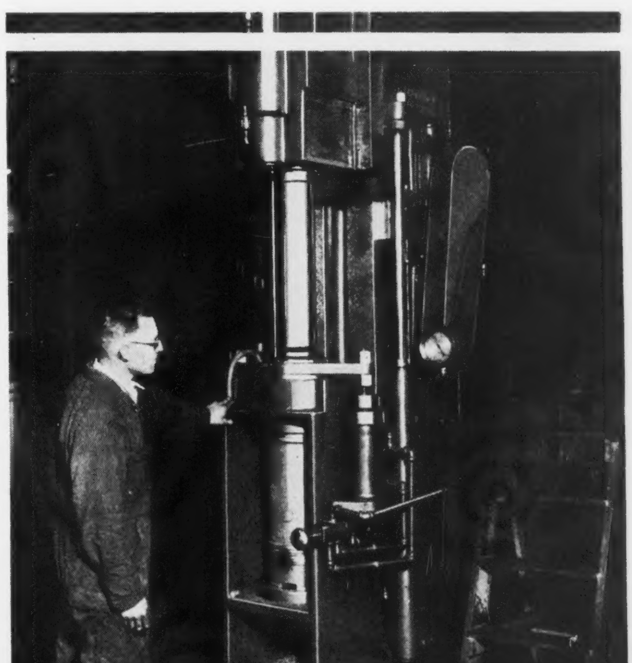


Fig. 5. Boring and Reaming Liners for Diesel Engines on a Baker Hydraulically Fed Drilling Machine

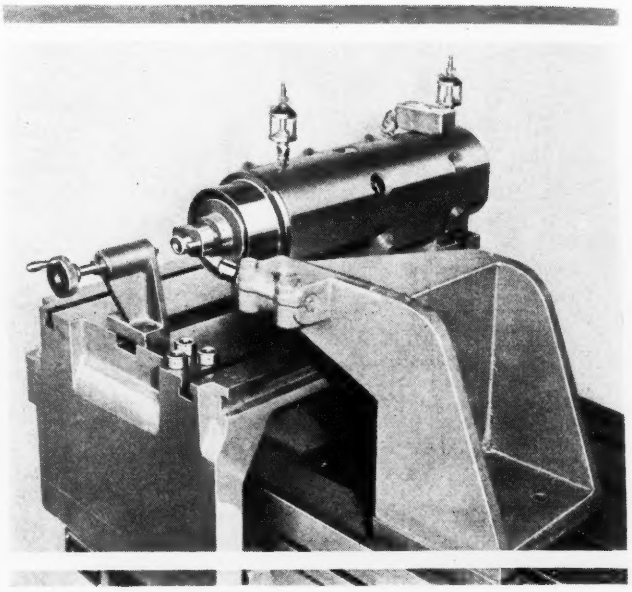


Fig. 6. Ex-Cell-O Diamond Boring Machine Facing a Bronze Seal Ring for a Gas-tight Fit

rods, pistons, bushings, magneto housings, pump bodies, and motor end-shields, can be rapidly bored in multiple-spindle diamond-tool boring machines. Such machines, designed primarily for high production, are automatic, except for loading and unloading. In boring the wrist-pin and crankpin holes of connecting-rods, a production of 4800 rods is obtained in an eight-hour day.

In another case, 260 automobile pistons per hour constitute the output of two diamond boring machines operated by one man. Each machine rough- and finish-bores the piston-pin hole to the specified size, straightness, and roundness within a tolerance of plus or minus 0.0001 inch. This high production is obtained by using hydraulically operated equipment for automatically locating and clamping the pistons in the fixture and for feeding the fixture to the rough- and finish-boring spindles. Six boring spindles, three roughing and three finishing, enable three pistons to be finished at each cycle.

Connecting-rods are bored at both ends in the same type of machine, with a production of 170 per hour. These holes are bored with an accuracy of plus or minus 0.0002 inch.

In another precision-boring machine, hydraulic equipment provides smooth operation of the table at feeds ranging from 1/2 to 15 inches per minute, as well as at the maximum rapid traverse of 15 feet per minute. Holes from 5/16 to 5 inches in diameter and up to 7 inches in length can be bored. Valves govern every function of the machine except the starting and stopping of the driving motor and the loading and unloading of the fixtures.

Bronze seal rings for gas compressor units of electric refrigerators are faced with extreme accuracy on the diamond boring machine shown in Fig. 6. The work is mounted on the nose of the boring unit in this case, and is rotated while the tool remains stationary. Approximately 0.010 to 0.012 inch of stock is removed. No further operations are required on this part, which was formerly finished by lapping. Diamond boring has greatly increased production and reduced rejections.

An unusual feature of one jig-boring machine is an electrical stop by which the accurate location of the slide becomes automatic. The snapping of a toggle switch causes the machine table to be moved at a uniform speed by means of a magnetic-clutch-driven lead-screw. As a contact fastened to the table touches an anvil on the vernier slide, the magnetic clutch releases the lead-screw, and the table stops in a predetermined position. It is claimed that it is possible to stop the table within an accuracy of 0.0002 inch.

Another recent vertical jig-boring machine is especially adapted for boring the top and bottom sections of cast-iron sub-presses on which punches and dies are to

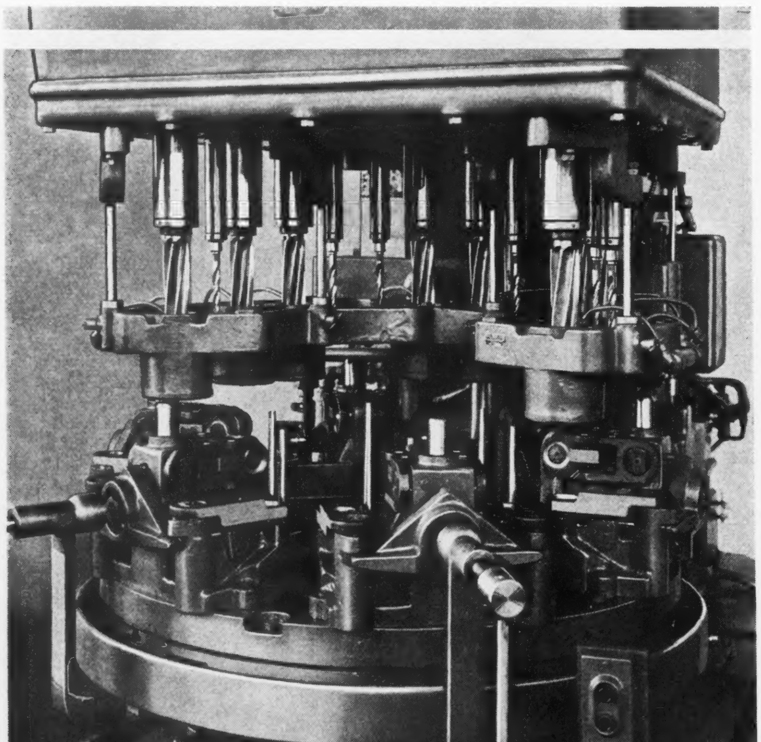


Fig. 7. Drilling and Counterboring 280 Tractor Track-links an Hour on a National Automatic Tool Co.'s Vertical Multiple-spindle Drilling Machine

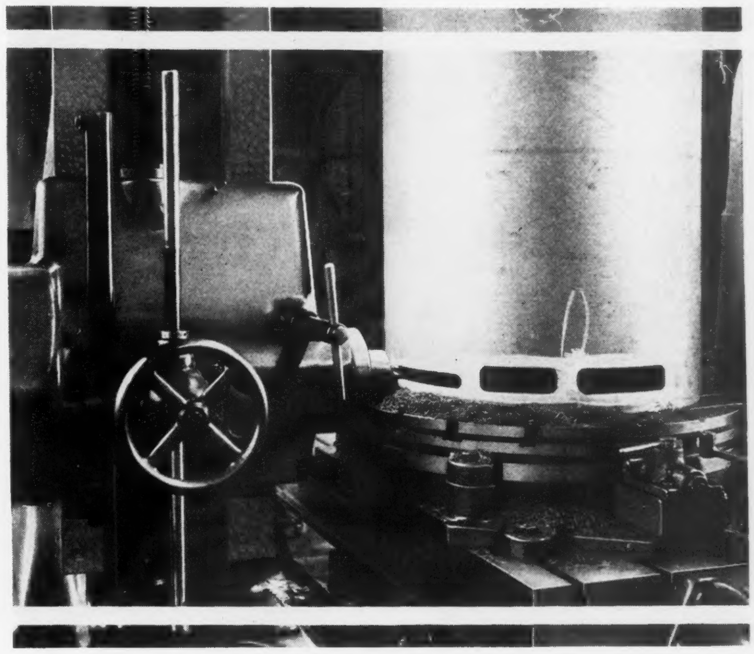


Fig. 8. Lucas Horizontal Boring, Drilling, and Milling Machine in a Railroad Shop Engaged in Milling Ports in Locomotive Cylinder Bushings

be mounted for blanking and piercing laminations.

The bores in automobile and other gasoline engine cylinder blocks, irrespective of the number of cylinders, are now finished simultaneously by honing on multiple-cylinder honing machines. Some types of these machines have hydraulically reciprocated spindles. High output is one of the features of these machines. Cylinder blocks in which the bores have been reamed uniformly within limits of 0.0015 and 0.0030 inch of the required size can be finished to a tolerance of 0.0005 inch at a production rate of 100 cylinder blocks per hour. Strokes of from 1 to 16 inches are available through a simple adjustment.

Very rapid improvements have been made in the hones used for honing cylinders and bores in general. Improvements have been introduced to correct uneven stone wear and to eliminate the possibility of scoring the cylinder walls. Means are provided for the quick and positive collapse of the hone at the completion of the work.

Automatic contraction and expansion of hones is now made possible with a drive-head that may be applied to any regular type of honing machine. Such a device saves much time by eliminating the necessity of contracting and expanding the hone by hand. One setting of the micrometer adjustment suffices for honing all bores of the same diameter to correct limits. The only additional adjustment needed is to compensate occasionally for the wear of the abrasive elements.

The bores of V-type cylinder blocks for eight-cylinder automobile engines are finished accurately and rapidly by the multiple-cylinder honing machine shown in Fig. 9. An electrically controlled device causes the hones to be withdrawn after a predetermined number of strokes. The operator then opens a valve controlling a hydraulic mechanism that automatically indexes the cylinder block 90 degrees and gives it a lateral movement of 7/8 inch, which brings the cylinders in the other bank into the honing position. About 0.002 inch of stock is removed by the honing operation. The time required for honing and indexing is 45 seconds.

The notches and the through holes in transmission gear-shifter shafts like the one shown in Fig. 12 are produced at the rate of 850 shafts per hour on the automatic drilling machine shown in Fig. 11. Two shafts are loaded in the machine at a time, one being the high and intermediate shaft, and the other the low and reverse shaft. The difference between the two shafts is in the location of notches and the drilled holes. Automatic indexing, automatic clamping and releasing of the work, and electrical engagement of the tool feeds synchronized with the table indexing movements are features of this

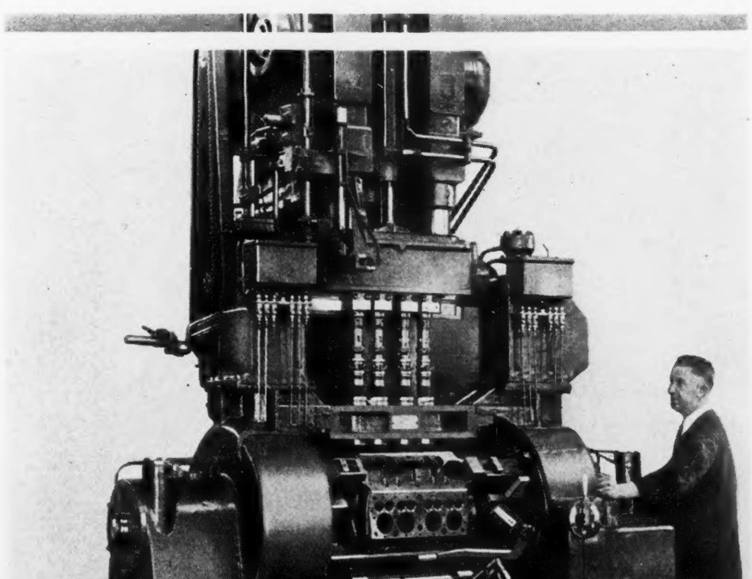


Fig. 9. Honing the Cylinders of a V-type Cylinder Block in 45 Seconds on a Barnes Drill Co.'s Honing Machine

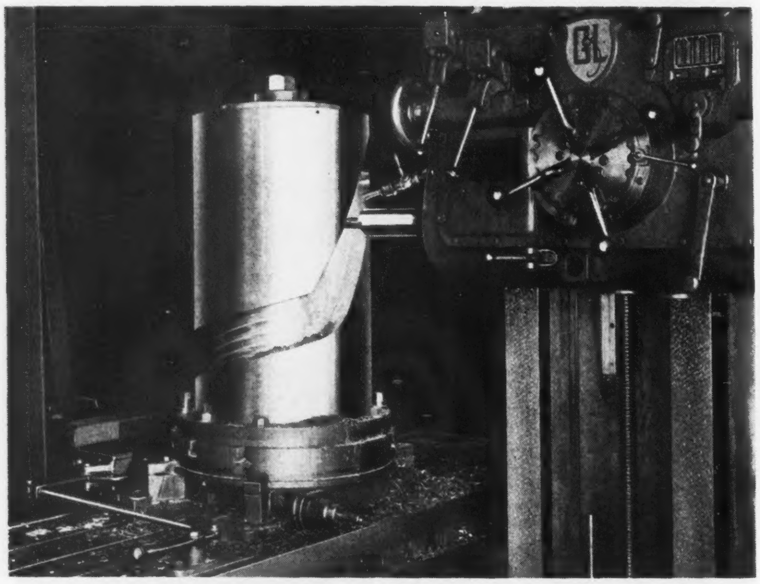


Fig. 10. Milling a 5-inch Wide by 2-inch Deep Groove Entirely Around a Forging on a Giddings & Lewis Machine, Reducing the Machining Time to About One-third of that Formerly Required

machine. Each operating cycle is started by pressing a button when the loading is completed.

Horizontal Boring, Drilling, and Milling Machines

Horizontal boring, drilling, and milling machines are now being built in very large sizes, having vertical capacities up to 72 inches and a table width of 60 inches. Machines of this size have beds measuring 5 feet across the outer two of the three ways, with a saddle 10 feet long.

An interesting development in a combination horizontal boring, drilling, and milling machine weighing 180,000 pounds is an electrical control which is concentrated in a small panel at the upper left-hand corner of the head. Through push-buttons on this panel the driving motor is started and stopped; the machine itself is started, stopped, and reversed; the feed or rapid traverse is applied to any unit in either direction; and any or all units can be clamped in any position. Small colored lights on the panel indicate at a glance what units are clamped and also what parts of the machine are working.

Locomotive cylinder bushings are mounted on the revolving table of a horizontal boring, drilling, and milling machine, as shown in Fig. 8, for milling the ports indicated. The ports in the piston-valve bushings are also milled in a similar manner. The revolving table, which is 36 inches in diameter, is graduated in half-degrees and is also provided with a lock-bolt to secure it in four positions 90 degrees apart in order to facilitate machining at right angles, as in boring and facing cross-heads, etc. The revolving-table unit can be removed to give greater clamping surface for plain boring, drilling, and milling operations. Both power and hand feeds are provided for the revolving table.

Fig. 10 shows rather an unusual job for a horizontal boring, drilling, and milling machine. The groove around the solid steel forging shown on the table of the machine extends entirely around the forging and is 5 inches wide by 2 inches deep. It was cut in the machine shown in thirty-six hours. Previously, this grooving job took approximately one hundred hours.

Some Advances in Tapping Machines

Dial tapping machines of multiple-spindle construction, so designed that the spindles can be interchanged in master plates to suit different kinds of work, have greatly increased the speed of tapping operations.

A reversing-type tapping machine, which constitutes a radical departure from past designs,

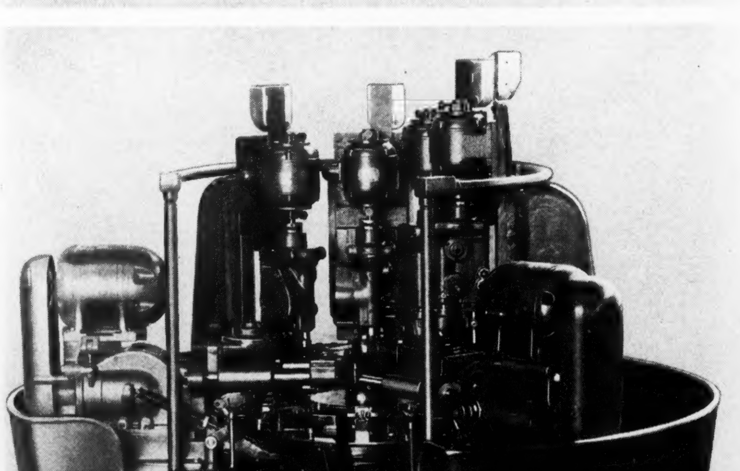


Fig. 11. Kingsbury Automatic Drilling Machine Notching and Drilling Shaft Shown in Fig. 12 at the Rate of 850 an Hour

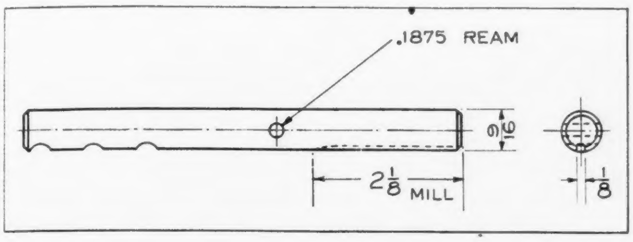


Fig. 12. Gear-shifter Shaft Notched and Drilled on Machine in Fig. 11

employs no clutches or gears for reversing the spindles; instead, they are positively driven in either direction by means of hydraulic equipment. The indexing, locking, tapping, and reversing are all performed hydraulically on this automatic tapping machine.

In one type of automatic nut-tapping machine, a production of 3120 3/8-inch hexagonal nuts with 24 threads per inch has been obtained per hour. Remarkable production records of this type could be cited almost indefinitely.

The X-Ray and the "Electric Eye" in Industry

Not many years ago the idea of using X-ray equipment in a machine shop, particularly in a boiler shop, for the inspection of the equipment being built would have been considered absolutely impossible. Today, however, we find X-ray equipment being used for discovering defects in castings and forgings, and the application has recently been extended to the inspection of welds.

One boiler manufacturer has equipped his shop with apparatus that determines quickly and definitely the reliability of fusion welds without the necessity of cutting test pieces or otherwise damaging the weld. Boilers and drums up to 12 feet in diameter and 30 feet in length can be readily X-rayed. This inspection is especially valuable as a final check on vessels that must withstand high pressures—up to 1400 pounds per square inch. From the negatives or the photographs reproduced, the inspector can detect any porosity, slag, cracks, or other defects that may exist in the welds.

One of the most important industrial applications of X-rays has been in foundry practice. Pattern designs, molding methods, and melting practice are frequently the cause of shrinkage cracks, cavities, and blow-holes that are not apparent on the surface but may cause failure of the casting after it has been placed in service. Through the use of X-ray pictures, defects such as these can be detected and steps can be taken to remove the cause. In some foundries today, when large lots of castings are to be made from a new pattern, the first casting is sent to an X-ray laboratory for an inspection. Defects can then be eliminated by changing the location of gates and risers, improving the melting practice, pouring at a different temperature and at a different rate, or making any other changes necessary.

Some Applications of the Photo-Electric Tube

One of the most interesting applications of the "electric eye"—the photo-electric tube—to a practical engineering problem has been in the regulating of both the diameter of the wire and the reeling apparatus of wire-drawing machinery. As the wire is drawn through the die at a constant speed, the speed of the re-reeling spool must be gradually decreased to conform with the increase in the diameter of the surface on which the wire is wound. This involves a problem in automatic regulation that is difficult to solve by mechanical devices only. By the application of a photo-electric cell, this problem has been solved. The wire diameter can also be constantly checked by electric means.

Steel bars, as they pass from the rolls of the rolling mill, are now being cut to the proper length by the aid of the photo-electric eye, at the plant of the Bethlehem Steel Co., Lebanon, Pa. As the bars are still hot when they leave the rolls, they give out enough light to actuate a photo-electric tube, and thus cause the operation of a shear that cuts the bars to the required length, even though they travel at a speed of 1200 feet per minute, or nearly fifteen miles per hour. When the machine is once set, all bars are cut off to the same length. To change the length of the cut, it is only necessary to move the photo-electric tube to another point.

Another practical application of the photo-electric tube is on a conveyor system. In many conveyor installations, it is necessary to switch the product from one conveyor line to another. By the placing of two small "flags" or projectors in different positions on each container passing along the conveyor, a convenient means is provided for switching the containers. Flags in a certain predetermined position will intercept two light-beams simultaneously and thereby operate a photo-electric relay which, in turn, actuates the switching equipment that sends the moving containers with their material to their proper destination.

Still another application of the photo-electric tube is for automatic weighing of materials. A weighing scale of the dial type is now available which is equipped with a photo-electric tube that automatically controls the valves, gates, or conveyors for filling containers with granular or liquid materials of a predetermined weight.

Milling Practice Has Reached a High Degree of Efficiency

Equipping for the New Needs of Industry
Section 7

So much has been published recently on up-to-date milling practice that it is not necessary to dwell at length on the recent advances in this field. A few outstanding examples of efficient practice will serve to illustrate the progress that has been made.

High-speed milling machines designed for economical milling with all types of cutters have been developed especially to meet the requirements for high speed incident to the use of cemented carbide-tipped cutters. Hence, spindle speeds from 15 to 1500 revolutions per minute, with feeds from 1/4 to 60 inches per minute, are now available in standard machines.

Marked increases have been shown in the production obtainable on plain milling machines by using work fixtures of the drum type. Because of their rotary design, application of these fixtures at once converts a plain milling machine into a continuous milling machine at a relatively low cost.

Vertical milling machines with constantly revolving work-tables are available for high-production work. Such operations as face-, side-, and straddle-milling, slotting, form-cutting, and the finishing of radial faces are among the classes of milling that can be conveniently handled on machines of this type.

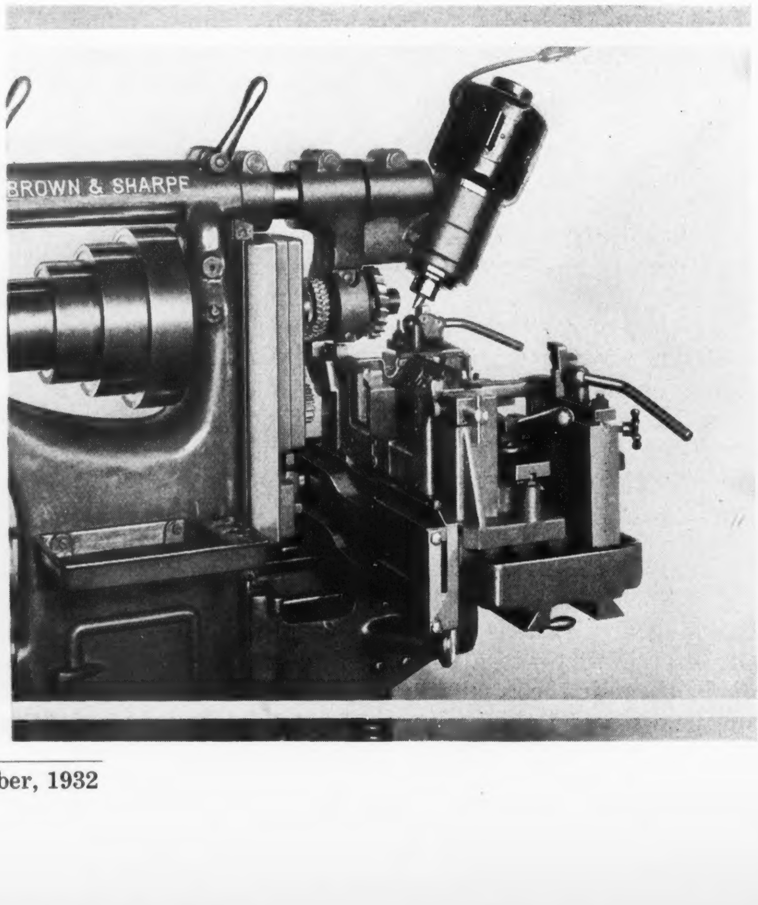
Another improvement is the so-called "bridge-type" vertical milling machine, adapted to face-milling, die-sinking, routing, profile-milling, jig and fixture machining, and other classes of work where several surfaces are to be milled on different planes. The bridge or rail is raised or lowered by power. The saddle, which is mounted on the rail and carries the vertical ram and spindle, can be traversed in or out across the table by means of the power feed or by the power rapid traverse. The spindle ram is also provided with a power down feed at a rate that is suitable for boring operations.

Among the innovations in milling machines should also be mentioned the so-called "dual control," by which all the movements can be controlled completely either from the front or the rear operating position. Independent control levers are placed both at the front and at the rear for operating the power feeds to the table, saddle, and knee of the machine.

Another improvement in milling machines is a four-position turret stop and dial indicator, which makes it possible to set the spindle quickly to different positions for step-milling, and also facilitates jig-boring and die-sinking.

Milling machines of standard make can be equipped with one or more vertical spindle carriers for "dodging" around obstructions. The car-

Fig. 1. Milling Alignment Pads on Typewriter Frames on a Brown & Sharpe Milling Machine at the Rate of 36 Frames an Hour



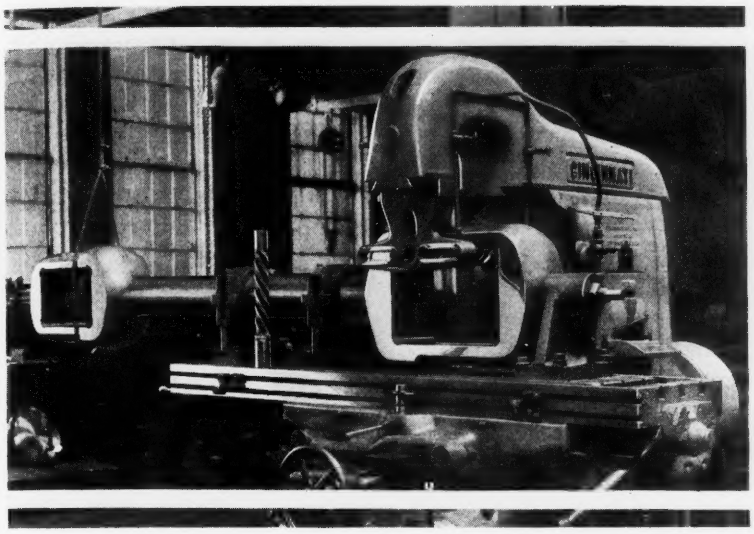


Fig. 2. (Left) A Cincinnati No. 5 Plain Milling Machine Reducing the Time of Milling Large Forged Connecting-rod from 25 to 9 Hours. The 3- by 18-inch Cutter Operates at a Cutting Speed of 53 Feet per Minute, Removing 3/16 Inch of Stock

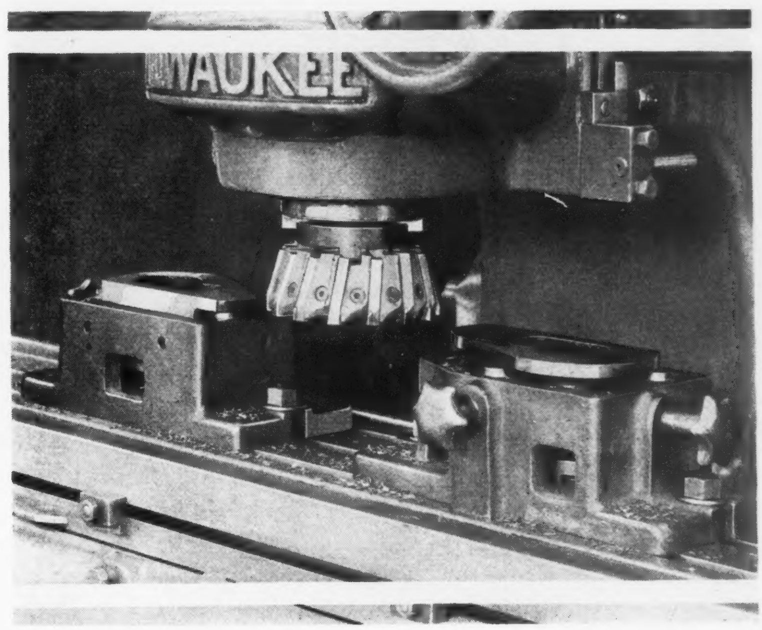


Fig. 3. (Right) Kearney & Trecker Milling Machine Equipped for Milling Cast-iron Plates, 6 Inches Wide by 7 Inches Long, at the Rate of 180 an Hour. The Use of Tungsten-carbide Cutters Permits a Cutting Speed of 300 Feet per Minute; the Depth of Cut is 1/8 Inch

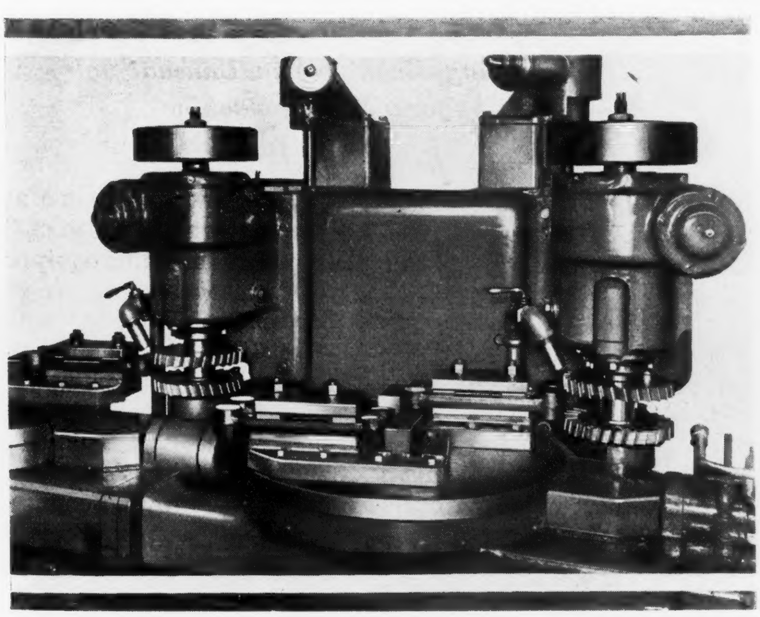


Fig. 4. (Left) Straddle-milling 90 Pratt & Whitney Aircraft-engine Articulated Forged Rods an Hour on a Sundstrand Twinplex Milling Machine, with a Cutting Speed of 100 Feet per Minute and a Feed of 3 Inches per Minute

riers slide on the over-arm of the machine and are hydraulically controlled. They guide the cutters automatically around the obstructing parts of the work.

High-speed milling attachments, having a separate motor so that the attachment can be mounted on the over-arm of a milling machine, provide for driving cutters at speeds of from 500 to 5000 revolutions per minute, using a 1/4-horsepower motor. Such heads, when arranged so that the whole head may be swiveled, can be set to mill in any position throughout the entire range of 360 degrees.

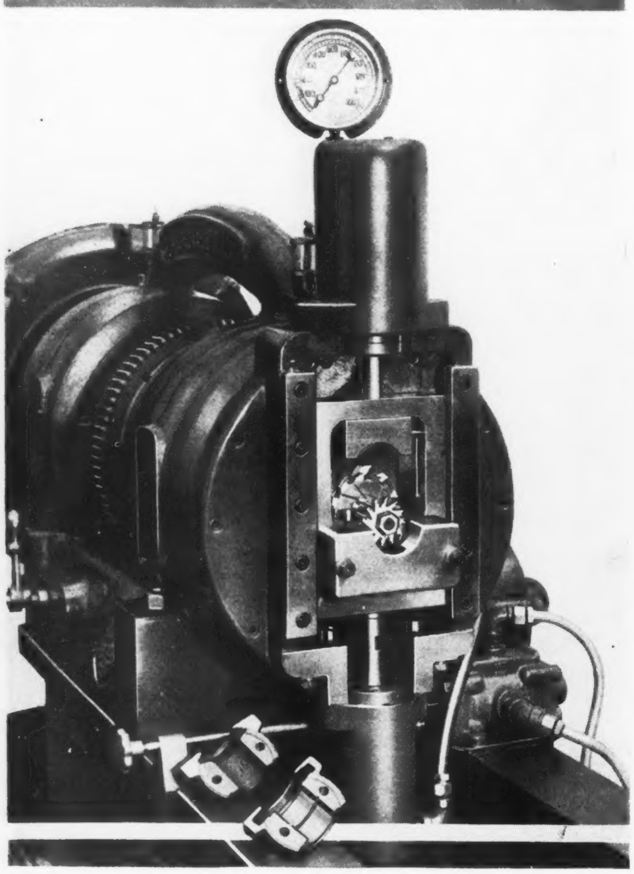


Fig. 5. A Hall Planetary Milling Machine, Equipped with Hydraulic Chuck, Finishing the Bores and Ends of 45 Half-bearings an Hour

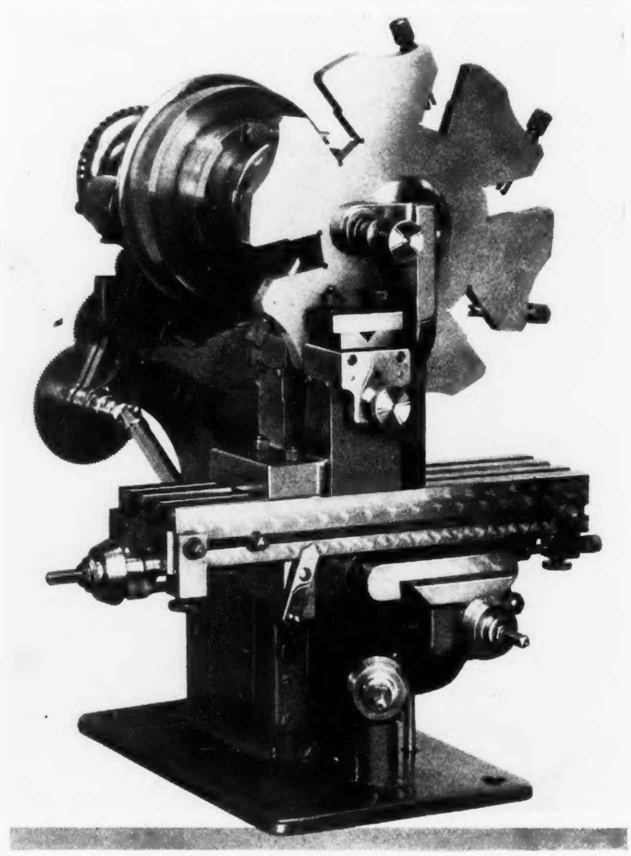


Fig. 6. Equipment for Making Accurate Cubes on a Hardinge Bros. Bench Milling Machine—an Unusual Job for a Milling Machine

Improved Holding Means for Inserted-Blade Cutters

Apart from the improvements made in tungsten-carbide tipped milling cutters, the main developments in cutters have been in the methods employed for holding inserted blades in the cutters. The holding means usually vary according to whether high-speed steel blades or Stellite blades are inserted. When tungsten-carbide tipped blades are used, a special design is generally employed. On modern face-milling cutters, the cutter bodies are frequently cone-shaped, so that the blades are placed at an angle to the body axis. This construction facilitates the maintenance of a uniform outside diameter as the blades become worn. The blades are adjusted outward and are then ground on the bottom and on the peripheral faces to obtain uniformity.

A number of examples showing the application of milling machines to the machining of a variety of industrial products, selected from many plants throughout the country, are illustrated and described in the following paragraphs.

Six alignment pads on a typewriter frame are milled to close limits of accuracy at the rate of 36 frames an hour on a plain milling machine equipped as shown in Fig. 1. Two of these machines are run by one operator, one machine being loaded while the other is cutting. Besides the work-holding fixture, the equipment includes an angular milling attachment, a gang of three plain mills, and a cam attached to the rear of the table for automatically lowering and raising the work to clear projections.

The milling operation on a large forged connecting-rod shown in Fig. 2, which was performed in the plant of the Worthington Pump Co., Buffalo, N. Y., illustrates the adaptability of a standard

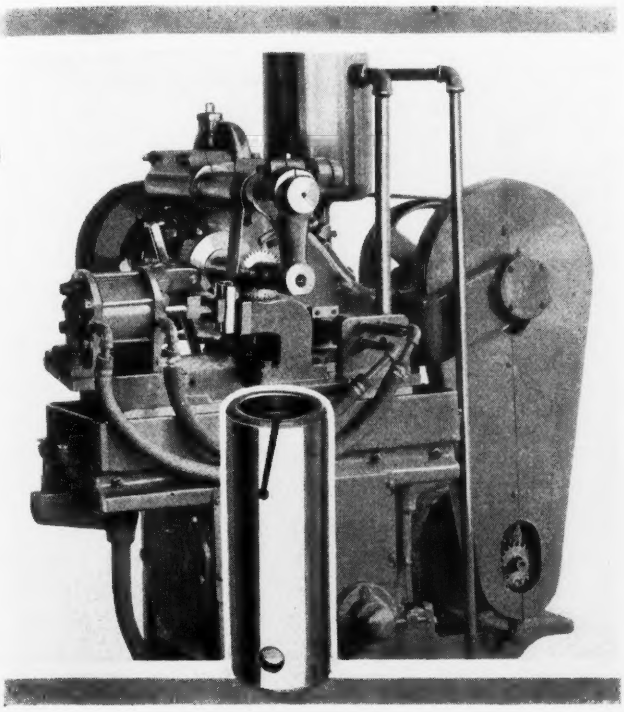


Fig. 7. Piston-pin Slotting Job Performed on a Kent-Owens Semi-automatic Milling Machine at the Rate of 700 Pieces an Hour

milling machine for special operations. The work consists of milling the openings in the ends of the rod with a 3- by 18-inch cutter, operating at a cutting speed of 53 feet per minute, with a table feed of 1 inch per minute, removing 3/16 inch of stock. The floor-to-floor time is 9 hours per rod, compared with 25 hours previously required. The rod is 9 feet 5 inches long, weighs about 3500 pounds, and is used on a 1300-horsepower gas engine. The milling machine is equipped with a "gooseneck" over-arm to avoid interference with the work. The work is held in a simple fixture, the outer end being supported by a counterweight.

Results Obtained through the Use of Carbide-Tipped Cutters

In exceptional instances, production has been increased more than 300 per cent by the use of tungsten-carbide tipped cutters. The average increase in production, in three typical cases, was 116 per cent. The job illustrated in Fig. 3 consists of milling cast-iron cover plates, about 6 inches wide by 7 inches long, on a new vertical milling machine at the rate of 180 pieces per hour, as compared with 63 pieces per hour on the old machine. The cutting speed with the old machine, using high-speed steel cutters, was 80 feet per minute; with the new machine and tungsten-carbide cutters, 300 feet per minute; depth of cut, 1/8 inch in both cases.

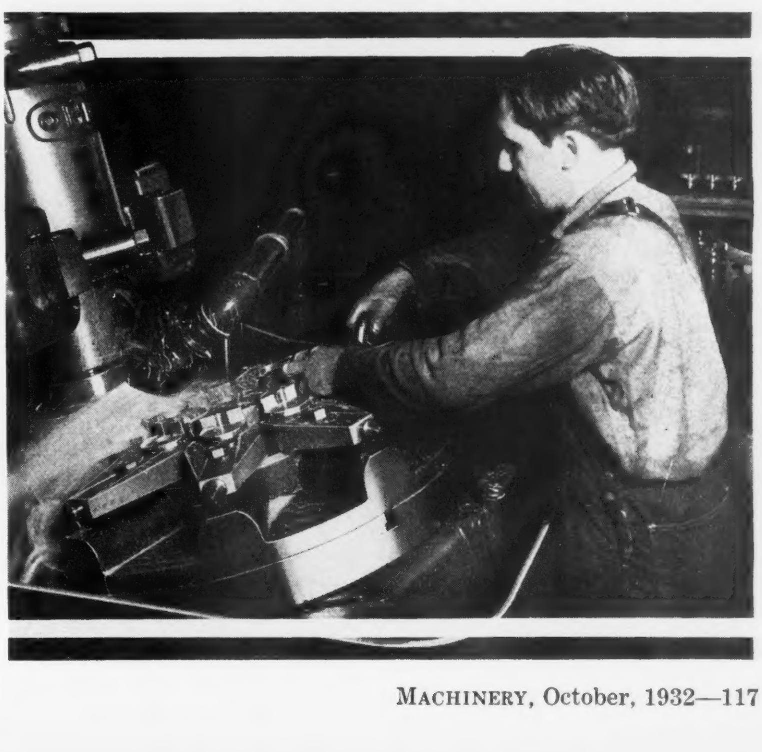
A High-Speed Operation on Airplane Parts

Eight surfaces are straddle-milled simultaneously on four articulated rods at the plant of the Pratt & Whitney Aircraft Corporation, as shown in Fig. 4. The forgings for these rods are made of No. 2340 steel. The cutting speed is 100 feet per minute, the feed 3 inches per minute, and the actual production, 90 rods per hour. One index-table holds the work in position for milling one end, and the other table holds it while milling the opposite end. Both index-tables are fully automatic, being hydraulically operated, timed, and interlocked with the reciprocating cycle of the machine table. The milling of the work at the two stations proceeds while the work is being loaded in the other two stations. The indexing of the work in a horizontal plane assures parallel faces on both ends of the rod without reference to the accuracy of the indexing movement.

Ends and Bores of Half-Bearings are Machined by Planetary Milling

All the half-bearing surfaces and the ends of the bores of the half-bearings seen in Fig. 5 are finished in one pass of the planetary milling cutters shown. The material is a strong tough steel, yet the production is 45 pieces an hour. One pound of material is removed from each piece. The tolerances are plus or minus 0.001 inch on all surfaces.

Fig. 8. Milling Two Faces of a Bearing Plate for Gabriel Shock Absorbers on an Oesterlein Ohio Tilted Rotary Milling Machine. Production, 120 an Hour



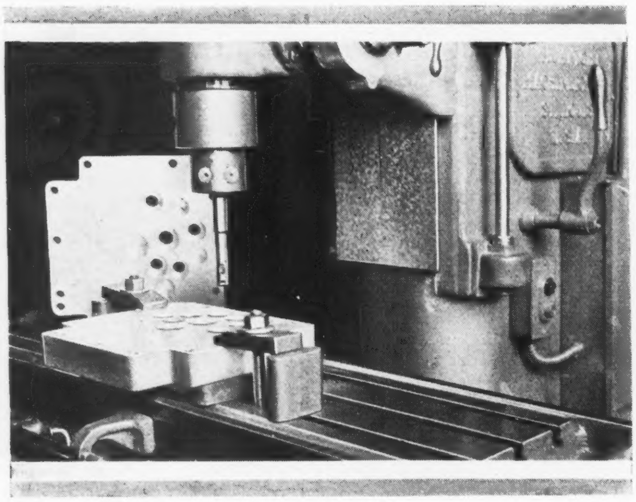


Fig. 9. An Accurate Hole-locating and Boring Job Performed on a W. B. Knight Machinery Co.'s Milling Machine. Center-to-center Tolerance, 0.0002 Inch

For machining, the half-bearing is located on the lower jaw of the chuck by two pins that fit into corresponding holes in the work. The loading is done when the jaw is in the upper position above the tops of the cutters. The clamping jaws are then closed tightly on the work by oil pressure. The pressure on the upper jaw is 7000 pounds per square inch, and on the lower jaw, 2000 pounds per square inch. Thus, the overbalancing pressure on the upper jaw causes the work to be fed down until the cutting depth is reached. At this point the planetary motion of the cutters begins.

Producing Accurate Cubes on Specially Equipped Milling Machine

Practically perfect cubes up to 3/4 inch in size are machined on a bench milling machine equipped with special fixtures, as shown in Fig. 6. After being rough-milled to within 0.005 inch of the finished size, six of the cubes are clamped in the radial slots in the 9-inch plate mounted on the machine spindle. When the plate is rotated, the opposite sides of the six cubes are finished simultaneously by diamond tools mounted in holders at each side of the plate. The extremely slow power feed gives a finish that practically eliminates the necessity for polishing the cubes.

Piston-pins such as shown in the insert in Fig. 7 are slotted on the machine illustrated, at the rate of 700 pieces an hour. The material is S A E 2130 steel, and the slot is 1/16 inch wide, 7/8 inch long, and is cut through the 1/8-inch wall. Two pins are slotted at one operation while held in an air-operated chuck, which is controlled by the movement of the table. Thus the work is clamped and released automatically. The table feed and rapid return movements are operated by a drum-type cam.

Milling Shock Absorber Parts with a High Degree of Accuracy

Fig. 8 shows the milling of two faces of a bearing plate for Gabriel shock absorbers at the rate of 120 an hour. These faces must be parallel with the back surface to a high degree of accuracy. A tolerance of plus or minus 0.0005 inch on the height and a finish that will permit of no leaks under the working pressures used in a shock absorber are specified. A single pass under the milling cutters finishes the parts to meet these requirements.

Locating and Boring Housings for Multiple-Spindle Drill Heads on a Milling Machine

The pieces shown on the machine table in Fig. 9 comprise the top and bottom plates for multiple-spindle drill heads made for the Carter Carburetor Corporation, St. Louis, Mo., by the W. B. Knight Machinery Co., of St. Louis. The holes in these plates were accurately located and bored on a milling machine in nine hours without the use of buttons or jigs. The center-to-center tolerance on this job is plus or minus 0.0002 inch.

Some of the holes are counterbored, some are through holes, and some are blind. All the holes are held to size within very close limits. Although the machine used for this precision boring job is built as a universal milling machine, it is also adapted for accurate jig boring, as indicated by the job described. The accurate spacing required for such work is obtained by the dial indicators and the micrometer end-measures provided for both the longitudinal and cross movements of the table.

The Fourteenth National Metal Congress and Exposition

DURING the week beginning October 3, thousands of men engaged in the mechanical industries will meet in Buffalo to take part in the National Metal Congress and the joint meetings of the leading engineering societies that will be held in that city. More than 125 companies will show their products at the Exposition that is to be held simultaneously with the Congress at the 174th Regiment Armory, under the auspices of the American Society for Steel Treating.

In conjunction with the Exposition, the American Society for Steel Treating will hold its annual convention. Twenty-seven technical papers relating to almost every phase of metallurgy and metal treatment will be read during the sessions, which will be distributed over the entire week.

In addition, the following societies will hold meetings—the American Welding Society; the Iron and Steel and Machine Shop Practice Divisions of the American Society of Mechanical Engineers; the Producticn Division of the Society of Automotive Engineers; the Institute of Metals and the Iron and Steel Divisions of the American Institute of Mining and Metallurgical Engineers; the Wire Association; and the Drop Forging Institute.

The American Society of Mechanical Engineers and the Society of Automotive Engineers will hold their sessions during the first day of the Congress, October 3, at the Hotel Statler. The social event in connection with this meeting will be a joint luncheon of the members of the two societies.

Mechanical Engineers Will Have a Busy Day

The mechanical engineers will hold their sessions in the afternoon and evening, with Thomas Githens of the Cleveland Twist Drill Co. presiding. Six papers covering a wide range of engineering problems will be read as follows: "The Influence of Oil Compressibility on Speed Characteristics of Hydraulic High-speed Presses," by Walter Ernst, development engineer, Hydraulic Press Mfg. Co., Mount Gilead, Ohio; "The Torque Required to Tap Cast Iron, Using National Coarse-thread Series and National Fine-thread Series Taps," by J. E. Miller, Alden, Iowa; "Recent Trends in Machine Tool Design," by Guy Hubbard; "Technique of Size Control in Precision Grinding," by R. E. W. Harrison, formerly chief engineer of Cincinnati Grinders, Inc., Cincinnati, Ohio; "Design of Products to Utilize Die-castings in Place of Machined Parts," by L. H. Morin, Doehler Die Casting Co., New York City; and "Materials for Modern Cutting Tools," by J. V. Emmons.

Automotive Engineers Will Discuss Machine Tools and Cutting Alloys

The automotive engineers will hold their meeting Monday forenoon, October 3. The program consists of two papers and the first showing of a motion-picture film of the production of high-grade die-castings. One of the papers to be read will deal with the design and performance of machine tools and their equipment from the point of view of the engineer who designs the products to be made on these tools. The author will approach the subject with the idea of adapting manufacturing equipment to the product rather than following the more usual practice of subjecting the design of the product to the ability of available machine tools to make the product economically.

The second paper will deal with recent advances in the new super-hard fast-cutting metal alloys and their wider application in production. The application of these new cutting materials is now extending beyond the limitations that governed their use until quite recently. It is expected that a number of new ideas of real value to production engineers will be presented.

The motion pictures showing the production of die-castings will bring to those attending the meeting a presentation of the newest developments in this field.

The American Welding Society will hold its regular scheduled fall meeting during the exposition week, with sessions covering four days About twenty-five papers have been scheduled for these different sessions, covering every phase of welding, including methods, materials, and testing of welds.

The machine is not to blame

THE remarkable advance made in machine tools, shop equipment, and materials, recorded in a series of articles appearing in this and coming numbers of MACHINERY, offers manufacturers the opportunity to effect substantial improvements in both shop methods and products.

The increasing efficiency of manufacturing methods has made it more and more possible for the average citizen to enjoy the conveniences, comforts, and recreations formerly available only to the few. It has helped largely to make life easier and more secure, and to fill it with wider interests and greater satisfactions. It is a record of progress and achievement—a contribution to the general welfare—of which everyone connected with the mechanical industries may well be proud.

In discussing the increased productive capacity of machinery and tools, it is well to emphasize—as has often been done in MACHINERY heretofore—that improved machinery is not the cause of unemployment and over-production.

On all sides we hear that labor-saving machinery is responsible for the depression. Not only is this idea voiced by labor leaders and politicians, but also by some manufacturers and industrial leaders. They draw this conclusion because it is near at hand and seems to them obvious. None the less, it is incorrect; the cause is deeper and, therefore, not so easily recognized.

Our industrial system is far from perfect; that is plain enough to everyone. But we must look beyond the machine if we expect to remedy the underlying trouble.

The manufacturer who produces a better product—or an equally good product for less money—makes a definite contribution to the general welfare. With the expenditure of less effort, more wealth has been created. The standard of living has been raised. Is it good sense to say that our troubles will be cured if we reduce this wealth-producing ability of labor?

Over-production is not the result of efficient machinery. It is possible to over-produce even with the most inefficient manufacturing methods. Production must be controlled to meet the demands of consumption in any case. Coordinated industry-planning could do a great deal toward achieving a balance between production and consumption.

Our difficulty is "under-consumption" rather than "over-production." Millions are suffering from the lack of goods that we are abundantly equipped to produce. In the early days, when industry was a home-grown affair, these men would have met their needs with the products of their own efforts; but now the individual is wholly dependent on industry. When industry breaks down, he is helpless—it becomes impossible for him to translate his individual productive ability into food, clothing, or other goods. The fault lies with our industrial system, and not with the individual. Hence, it is clearly up to industry to find an adequate remedy.

The difficulty is one that lies deep in the maze of our customs and social relations, and in our system of industrial organization, credit, and finance; but no matter how complex the problem, we must not be afraid to tackle it. The welfare of industry and the future of our present civilization depend on our ability to locate the trouble and apply corrective measures.

Meanwhile, we will continue to improve the efficiency of our manufacturing methods. If our effort in that direction is coupled with straight economic thinking and the courage to try new and better methods in finance and business, progress and a steadily rising standard of living will result.

AVERAGE STRENGTH DATA FOR IRON AND STEEL—1

Material Letters (a) etc., Indicate Foot-notes	Ultimate Strength, Pounds per Square Inch			Yield Point, Pounds per Square Inch	Modulus of Elasticity, Tension	Elongation in 2 Inches, Per Cent
	Tension	Compression Foot-note (m)	Shear			
Cast Iron, Soft.........	16,000	80,000	17,000	......	12,000,000	..
Cast Iron, Average.....	22,000	100,000	24,000	......	16,000,000	..
Cast Iron, Hard (a)....	35,000	150,000	38,000	......	20,000,000	..
Cast Iron, High-test (b)	45,000	200,000	50,000	......	....	..
Castings, Malleable	54,000	......	48,000	36,000	25,000,000	18
Castings, Steel (c).....	70,000	70,000	60,000	40,000	30,000,000	25
Carbon Steel (d).......	56,000	56,000	42,000	28,000	29,000,000	30
Cold-worked (e)	75,000	75,000	55,000	38,000	30,000,000	..
Casehardened (f)....	80,000	80,000	60,000	50,000	30,000,000	20
Hardened, drawn (g)	120,000	120,000	90,000	90,000	30,000,000	15
Machinery Steel (h)....	60,000	60,000	45,000	40,000	30,000,000	..
Nickel Steel (i)........	130,000	130,000	98,000	100,000	30,000,000	18
SAE No. 2330......	145,000	145,000	110,000	120,000	30,000,000	18
SAE No. 2340......	165,000	165,000	125,000	150,000	30,000,000	12

(a) Compressive strength of "white" and "high-test" irons may range from 175,000 to 250,000 pounds per square inch depending on proportions of test piece.
(b) Tensile strength may range from 40,000 to 70,000 or even higher.
(c) Heat-treated *alloy-steel* castings may have tensile strength up to 200,000 pounds per square inch.
(d) Soft open-hearth annealed steel.
(e) Yield point range from 40,000 to 60,000 according to amount of cold-working.
(f) Strength data for S A E No. 1020 casehardened steel, water-quenched and drawn to 400 degrees F.
(g) S A E No. 1045, hardened in water, drawn to 800 degrees F.
(h) Some "machinery" steels have tensile strengths ranging up to 100,000 pounds per square inch.
(i) S A E No. 2320. Strength data for all nickel steels listed based upon a drawing temperature of 800 degrees F. and oil-quenching.
(m) For columns made of soft or medium steels, subjected to compressive and bending stresses combined, use yield point as value for ultimate compressive strength.

MACHINERY'S Data Sheet No. 235, New Series, October, 1932

AVERAGE STRENGTH DATA FOR IRON AND STEEL—2

Material Letters (j) etc., Indicate Foot-notes	Ultimate Strength, Pounds per Square Inch			Yield Point, Pounds per Square Inch	Modulus of Elasticity, Tension	Elongation in 2 Inches, Per Cent
	Tension	Compression Foot-note (m)	Shear			
Nickel Chromium (j)...	125,000	125,000	95,000	95,000	30,000,000	18
SAE No. 3130......	150,000	150,000	110,000	125,000	30,000,000	15
SAE No. 3140......	175,000	175,000	130,000	150,000	30,000,000	..
SAE No. 3230......	180,000	180,000	135,000	150,000	30,000,000	15
SAE No. 3240......	200,000	200,000	150,000	180,000	30,000,000	15
SAE No. 3250......	220,000	220,000	165,000	200,000	30,000,000	12
Rivet Steel	57,000	57,000	44,000	36,000	29,000,000	..
Stainless Steel (k).....	225,000	225,000	....	185,000	....	9
Drawn 1290° F.	120,000	120,000	....	90,000	....	22
Structural Steel	60,000	60,000	45,000	30,000	29,000,000	..
Steel Wire (l).........	120,000	....	....	60,000	30,000,000	..
Annealed	80,000	....	....	40,000	29,000,000	..
Plow Steel	275,000	....	....	....	....	..
Music Wire	300,000	....	....	....	....	..
Wrought Iron	48,000	46,000	40,000	25,000	27,000,000	..

(j) S A E No. 3120. Nickel-chromium steels listed drawn to 800 degrees F.
(k) Strength data for steel drawn to 390 degrees F. Note also data for 1290 degrees F.
(l) Strength varies over a wide range, depending upon size and composition.
(m) For columns made of soft or medium steels, subjected to compressive and bending stresses combined, use yield point as value for ultimate compressive strength.

MACHINERY'S Data Sheet No. 236, New Series, October, 1932

Ingenious Mechanical Movements

Mechanisms Selected by Experienced Machine Designers as Typical Examples Applicable in the Construction of Automatic Machines and Other Devices

Indexing Cam for Varying Stroke of Follower

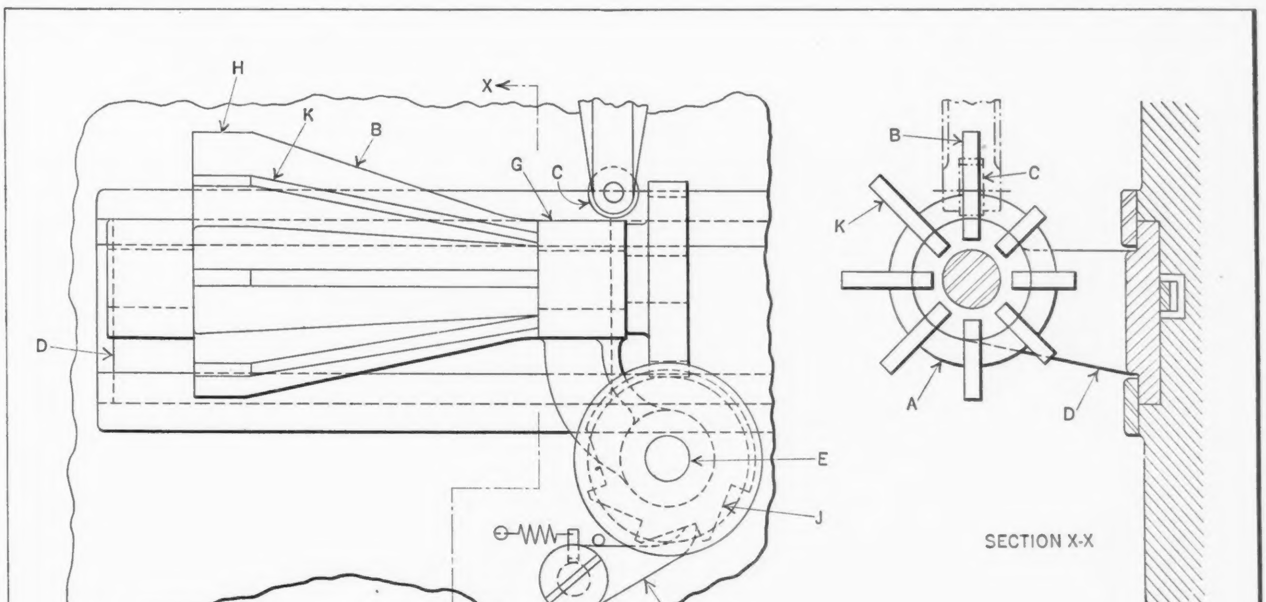
By J. E. FENNO

For a given number of strokes of a slide, almost any variation in the length of each successive stroke may be produced by means of an indexing cam mechanism like that shown in the illustration. The construction of this cam is economical and the design is unusually simple, when the movements involved are considered. The cam member consists of a core *A* in which are secured eight cam inserts *B*. Each insert is tapered at a different angle and has a throw corresponding with the required movement of the follower roll *C*.

The core is keyed to a shaft turning in bearings on the slide *D*, which is reciprocated through a rack and gear by a member of the machine in which the cam is used. To one end of the core shaft is keyed a helical gear, meshing with a similar gear on the vertical shaft *E*. This shaft, running in two bearings cast integral with the slide, carries a ratchet wheel *J*, which is operated by the pawl *F*, pivoted to the machine base. There are as many teeth in the ratchet wheel as there are inserts.

The various movements are obtained in the following manner: From the position indicated, the slide moves toward the right, causing the follower roll to ride along the bearing *G* and on the insert *B* to point *H*. The slide now returns, during which time the follower roll is also returned by means of a coil spring (not shown). Toward the end of the return stroke, as the roll dwells on bearing *G*, a tooth in ratchet *J* engages the pawl *F*. Upon the continued movement of the slide, the pawl forces the ratchet wheel around one tooth, causing the core to rotate until insert *K* is in line with the follower roll. Thus, on the return stroke, the roll rides on insert *K*, which imparts a shorter movement to the follower than the preceding one. In this way, each succeeding movement of the follower is varied until the core has been indexed one revolution. At this time, the roll will again be in line with the insert *B* and the cycle of movements will be repeated.

Although not shown, a friction brake should be applied to either the core or the ratchet-wheel shaft



Sliding Cam which is Indexed after Each Stroke to Present a Different Cam Edge to the Follower, thus Varying the Follower Stroke

to prevent over-run of the cam due to the momentum imparted by the pawl. Other combinations than that shown here may be obtained by using different inserts to vary the throw or a different number of inserts to increase or decrease the number of follower movements per cycle. In the latter case, the number of teeth in the ratchet wheel must be changed to correspond with the number of inserts.

Air-Chuck Valve that Reduces Air Consumption Forty Per Cent

By H. C. SHEAFFER

In shops using a large number of air chucks for machining purposes, the cost of maintaining the required air pressure is considerable, and as a rule, precautions are taken to prevent waste of air through leakage or other causes. Yet by giving closer attention to the design of the pneumatic apparatus, it is possible to reduce the air consumption as much as 40 per cent. For example, the full line pressure is commonly used for both opening and closing the chuck. While, obviously, the full line pressure is required for closing the chuck, only a fraction of this pressure is needed to release the jaws.

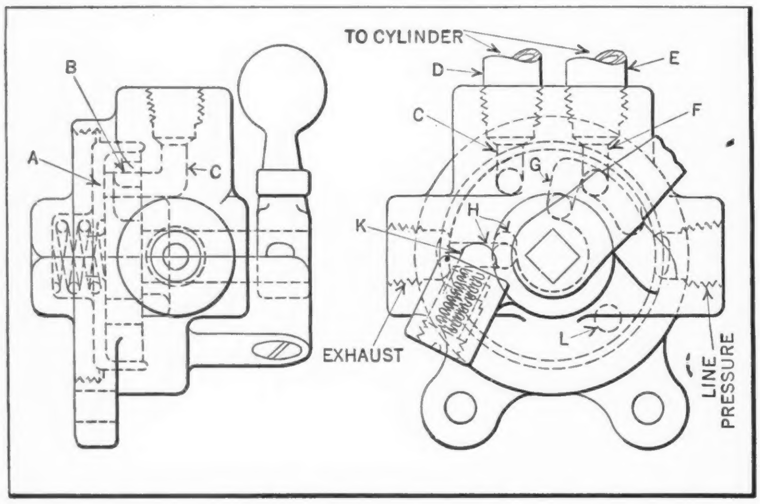


Fig. 1. Pneumatic Valve by Means of which the Same Air is Used for Opening and Closing a Chuck

Reasoning thus, the writer has developed a valve (see Fig. 1) by means of which the same air is employed for opening the jaws as is used for closing them. The principle can be more clearly explained by referring to a diagram of the air cylinder (Fig. 2). This cylinder is designed so that when the chuck is closed, the space on both sides of the piston will be about the same, as indicated.

To release the jaws, the piston must be moved toward the left. This is done by exhausting air from side *A* into side *B* until the pressure in both sides is equal. The air in side *A* is then exhausted into the atmosphere, leaving side *B* with about one-half of the line pressure —about 50 pounds —to expand and push the piston toward the left, in this way releasing the jaws. It is very seldom that a pressure of more than 45 pounds per square inch is required to release the chuck jaws.

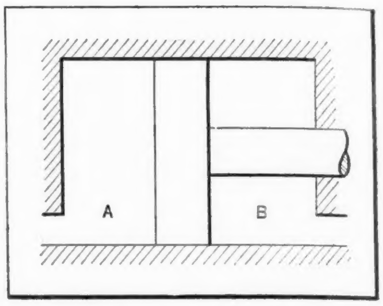


Fig. 2. Diagram of Air Cylinder with Piston in "Closed Chuck" Position

The valve (Fig. 1) that controls the air in the manner described is of the rotary self-seating type, which requires no packing. The position of the various ports in the valve body and disk are shown clearly in the detail views, Figs. 3 and 4, the reference letters corresponding in all views.

With the valve lever in the position indicated in Fig. 1, the air entering at line pressure passes over the disk at *A*, up through the hole *B* in the disk, out through port *C* in the body, and into the pipe *D* which leads into the left-hand side of the cylinder. The air entering the cylinder forces the piston toward the right and closes the chuck. During this movement, the air is exhausted from the right-hand side of the cylinder through pipe *E*, port *F* in the body, port *G* in the disk, port *H* in the body, and out through the exhaust opening to the atmosphere.

To release the jaws, the lever is swung toward the left until it comes into contact with the spring stop *K*. As the lever commences its movement toward the left, ports *G* and *H* are disconnected,

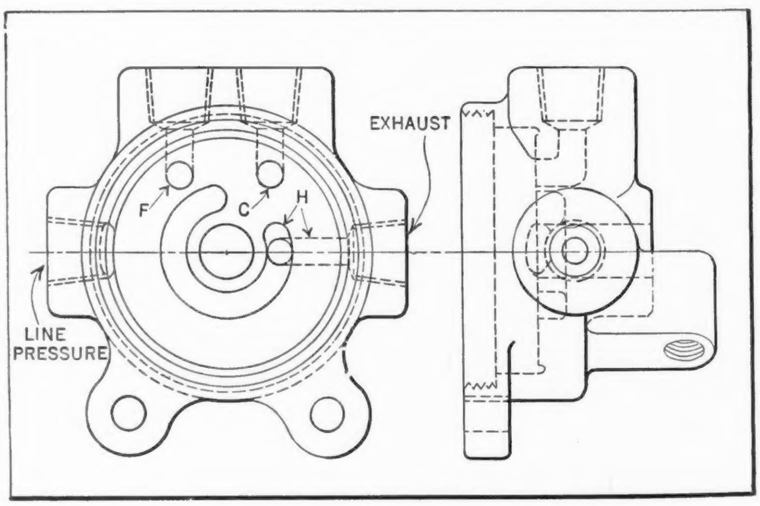


Fig. 3. Detail View of Body of Air Valve, Showing Positions of the Various Ports

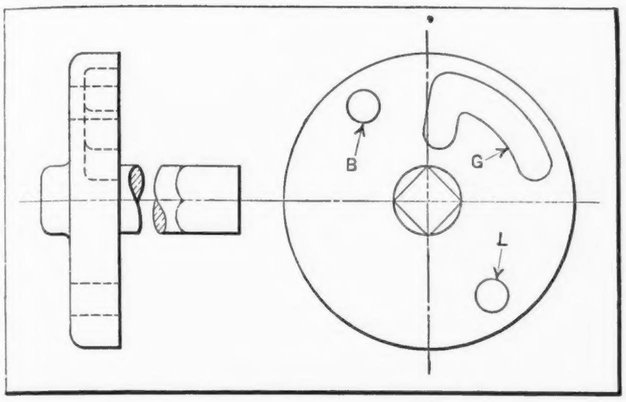


Fig. 4. Detail View of the Valve Disk

thus closing the exhaust from the right-hand side of the cylinder. At this time, ports *C* and *B* are also disconnected, closing the inlet and confining the air at line pressure to the left-hand side of the cylinder. Continued movement of the lever causes port *G* to connect ports *C* and *F*, so that the air is by-passed from the left-hand side of the cylinder to the right-hand side until the pressure on both sides of the piston is equal. Further movement of the lever disconnects port *G* from port *F*, thus closing the latter and confining the air to the right of the cylinder.

As the lever comes in contact with the spring stop *K*, port *G* connects ports *C* and *H*, and the air on the left side of the cylinder is exhausted into the atmosphere. Thus, air at a pressure of approximately one-half the line pressure is left on the right of the cylinder. This air expands, pushing the piston toward the left and opening the chuck jaws.

If for some reason this pressure is insufficient to release the jaws, the lever is forced farther toward the left, depressing the spring stop *K*. This additional movement of the lever causes port *L* to connect with port *F*, so that air at line pressure enters at the right of the piston and overcomes the resistance. When released, the lever will immediately spring back to the unchucking position, shutting off the line pressure.

Overload Friction Release for a Large Gear Drive

By WILLIAM CAMPION

Each machine operating the large valves for filling and emptying the locks of a certain ship canal has embodied within the main spur gear an overload friction release. The object of this device is to prevent damage to the valve-lifting mechanism in case the valve gate should be suddenly stopped by some obstruction.

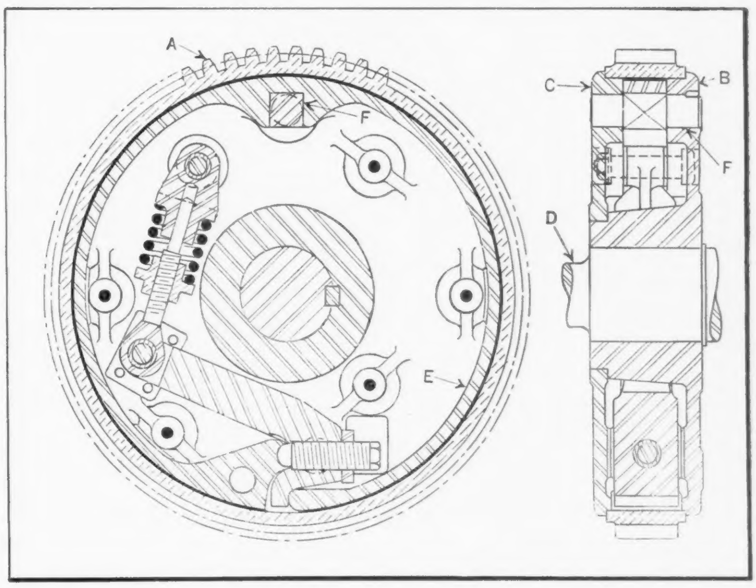
The main spur gear unit consists of a manganese bronze rim *A*, about 37 inches in diameter, with teeth cut on its outer face. The gear is free to rotate in a groove formed by the cast-steel casing *B* and the cover *C*, which are bolted rigidly together and keyed to the gear-shaft *D*. In the casing is an internal brake-band *E* of cast steel, which has an asbestos lining secured to it with copper rivets. The band is pivoted to the casing by the pin *F*.

A spring-actuated lever is provided to expand the brake-band and press it against the rim. Thus the torque is transmitted from the gear teeth through the brake-band to the casing and then to the shaft *D* to which the valve-operating drum is keyed. The spring mounting is adjustable, so that the proper load can be applied to the lever and the load regulated to compensate for wear on the band and rim. With this arrangement, the gear unit acts as a whole. However, should a log of timber or other foreign material obstruct the valve, slippage would occur between the bronze rim and the brake-band and thus prevent damage to the machine or valve.

* * *

Rapid Moving of a Factory

A remarkable record of moving a factory in full production is referred to in *Industrial Britain*. A factory employing 100 men was moved from its location in London to Chippenham, a distance of 94 miles, without any interruption in production. The removal included 750 tons of machinery and covered a period of several days. At the end of the working day, a part of the machinery in the old plant was dismantled, loaded on trucks, conveyed by road to the Paddington freight station in London, from where it was sent immediately by rail to Chippenham, arriving there in the early morning hours so that there was sufficient time to re-erect the machines and start them in operation at regular working hours the next morning.



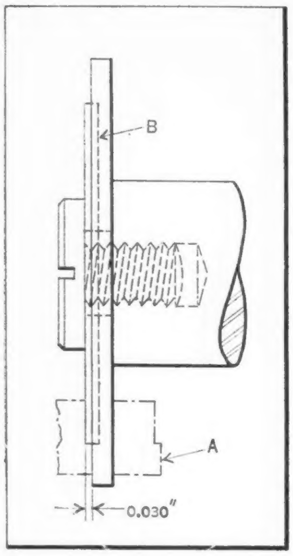
Overload Friction Release with Adjustment for Controlling Point of Release

Ideas for the Shop and Drafting-Room

Time- and Labor-Saving Devices and Methods that Have been Found Useful by Men Engaged in Machine Design and Shop Work

Gang Saw for Milling Narrow Shoulder While Cutting Off

The writer recently had occasion to tool up for the part shown at *A* in the illustration. The operation sheet specified that the part should be cut off and the 0.030-inch step milled in one operation on a hand miller. The step had to be milled accurately. In the first attempt, a 1/32-inch saw was ground down to 0.030 inch and "ganged" with a 1/8-inch cut-off saw. The result was unsatisfactory and inaccurate, because the thin saw had a tendency to weave and spring away from the thicker saw. A special cut-off saw was then made and recessed 0.032 inch deep, as shown at *B* to receive a standard 1/16-inch saw which would not spring so easily. This allowed the thin saw to project the required 0.030 inch beyond the face of the cut-off saw. No trouble was experienced with this arrangement.



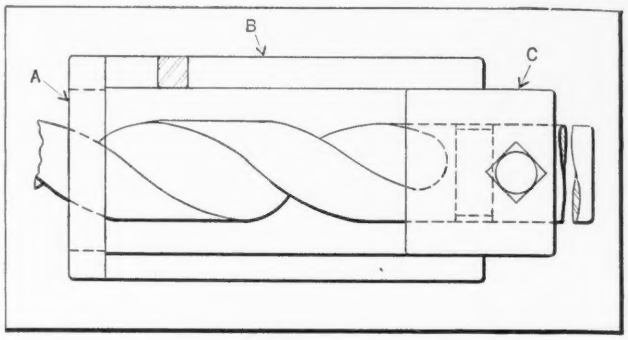
Gang Saws Arranged for Milling a 0.030-inch Shoulder and for Cutting Off

Millersburg, Pa. R. A. DRESSLER

A Drill Stop Having No Chip Interference

In drilling holes in brass castings chucked in a lathe, considerable difficulty was experienced with the clogging of chips in the drill flutes when an ordinary ring-shaped drill stop was used, as the stop obstructed the flow of the chips along the flutes. It was necessary for the operator to remove the drill from the hole several times before the proper depth had been reached in order to dispose of the chips.

To overcome this difficulty, the stop shown in the illustration was made. Two pieces of square stock *B* were welded to collars *A* and *C*. Collar *C* has a hole tapped in it to receive a set-screw for fastening the stop securely to the shank of the drill. The hole in collar *A* is bored considerably larger than the diameter of the drill, thereby providing ample space for the chips to be forced along the flutes.



Drill Stop of Welded Construction that Permits Free Passage of the Chips

Stops of the type described have been used successfully on drills ranging in size from 3/4 inch to 1 1/2 inches.

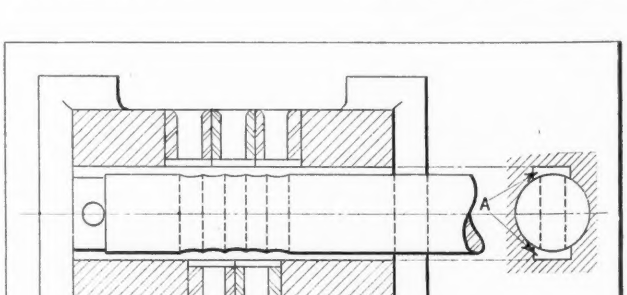
Meriden, Conn. P. L. BUDWITZ

Jig for Drilling Elongated Holes

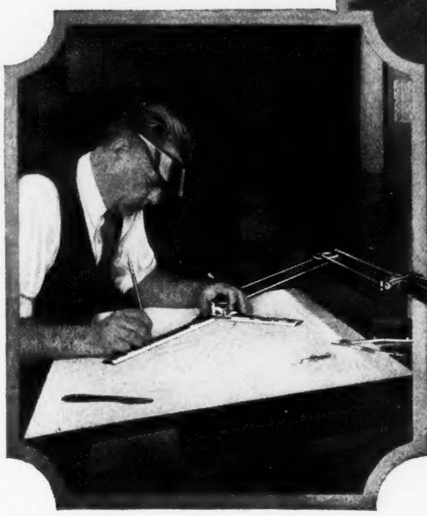
An inexpensive jig for rapidly drilling overlapping holes for slots can be constructed in the manner shown in the accompanying illustration. The piece to be drilled is so located in the jig that drilling operations may be performed from both sides at the same setting of the drill spindle stop. Three holes are drilled from one side of the jig and two holes from the other; in this way, any tendency of the drill to "run" into the previously drilled holes is avoided.

The clearance *A* for burrs is cut with a keyway broach and permits the work to be easily removed from the jig after the drilling is completed. A jig of similar design can also be used for drilling flat stock in which slots are required.

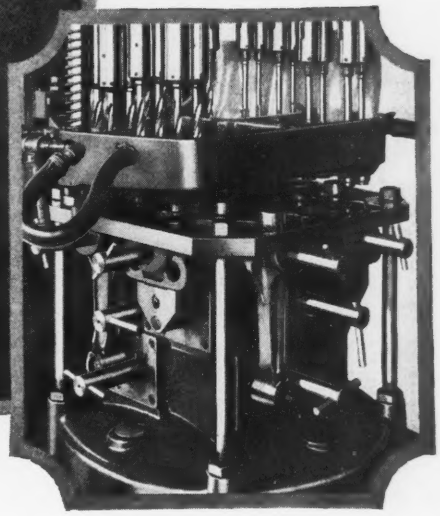
Franklin, N. H. WALTER A. SIMOND



Drill Jig for Removing Metal in Forming Elongated Holes



Design of Tools and Fixtures

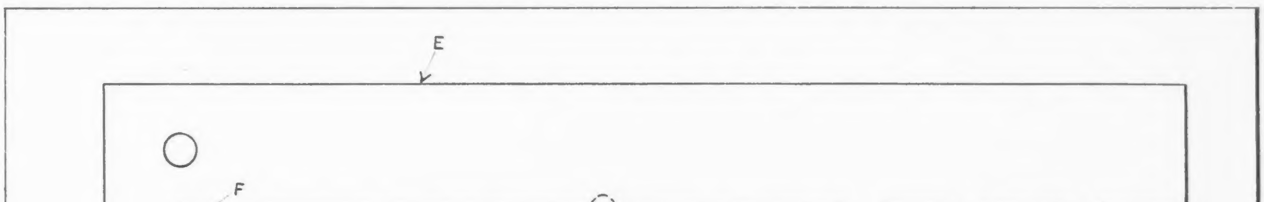


Inspection Gage for Checking Four Cross-Slots in a Shaft

By D. L. BROWN, Summit, N. J.

To insure interchangeability of the automobile gear shifter shaft indicated at *A* in the illustration, the location, depth, form, and angle of the V-slots *B* and the half-round slot *C* must be very accurate. Formerly these slots were checked by means of the profile gage *E*, with the accurately machined shoulder *F* as a measuring point. This gage, however, proved to be unsatisfactory because of the difficulty in determining just where the inaccuracies are. They may lie in either the location, depth, form, or angle of any of the four slots or in all of them.

To overcome this difficulty, the gage shown in the



Gage of the Flush Pin Type for Detecting Inaccuracies in Any One of the Cross-slots in an Automobile Shifter Shaft

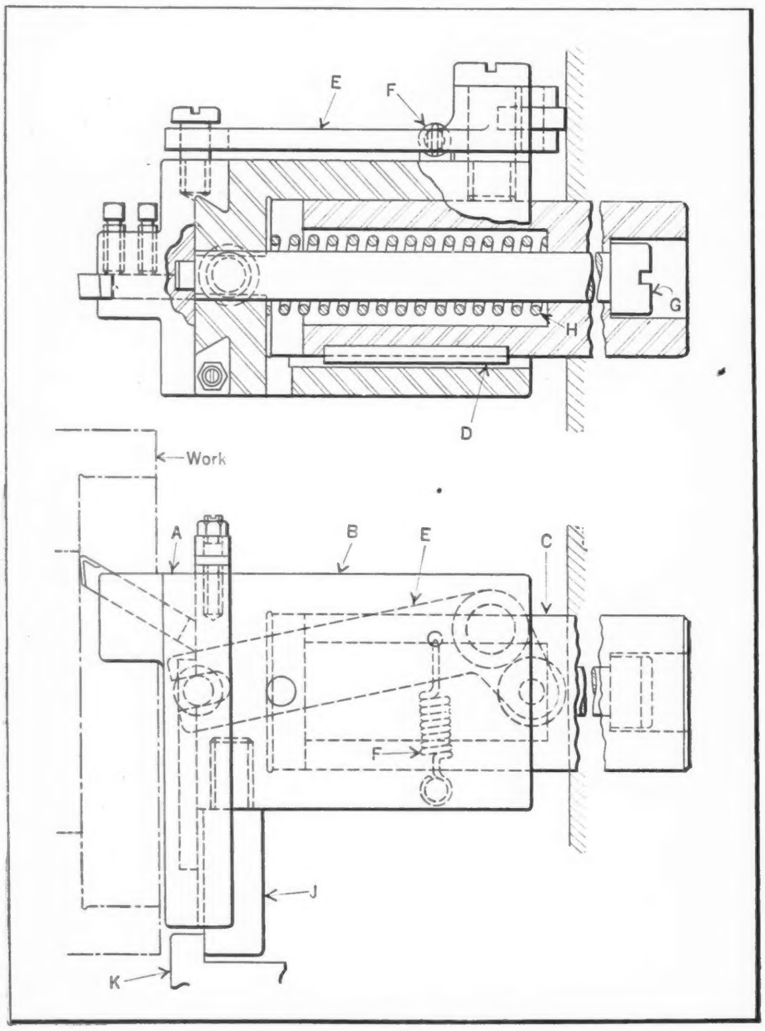
lower view was made. It consists of member *O*, which is provided with hardened and ground bushings for supporting the shaft. The shaft is locked in its gaging position by the gage pin *G*. Flush-pin gages *H*, shaped at their lower ends to the correct form of the V-slots, are a slide fit in member *O*, in which they are confined by the pins *J* in the elongated slots *K*.

The half-round slot is checked by the gage pin *L* entering the member *O* and engaging the slot at the correct depth and angle. With this arrangement, each slot is checked independently, so that any one of the four inaccuracies mentioned can be quickly detected. Both gage pins *G* and *L* are ground to high and low limit diameters, as indicated at *M* and *N*, so that the diameters of both the hole and the slot are also accurately checked.

Tool-Holder with Cross-Feed for Machining Wide Face During a Short Turret Travel

In setting up a turret lathe for machining a recessed gear, it was found that the only automatic facing tool-holder available was too long and had too short a cross-feed travel. A new facing tool was, therefore, built according to the design shown in the illustration. With this tool, a face over 2 inches wide can be machined with a turret travel of less than 3/4 inch.

The tool consists chiefly of the cross-slide *A*, mounted on the sleeve *B*. This sleeve slides on the shank *C*, which is fastened in the turret, and is prevented from turning on the shank by the key *D*. A lever *E*, pivoted on the side of the sleeve, is slotted at one end, the slot engaging a stud in the cross-slide *A*. A roller in the other end of the lever is held in contact with the face of the turret by the coil spring *F*. The movement of the sleeve on the shank *C* is limited by the stud *G*, and the sleeve is held in its outer position by the spring *H*. One end of stud *G* is turned down and engages a slot in the cross-slide, the length of the slot limiting the travel of the cross-slide.



Facing Tool Requiring only 3/4 Inch Turret Travel to Machine a Face 2 Inches Wide

A plug *J* in sleeve *B* engages a stationary stop *K* on the machine when the facing tool has reached its proper depth in the work, as indicated. As the turret continues toward the left, shank *C* slides into the sleeve, which is now stationary. At the same time, the turret face in contact with the roller is forcing the lever around in a clockwise direction, and the lever, in turn, is imparting the required movement to the cross-slide.

A tapered gib is provided for maintaining a close sliding fit for the cross-slide. Plug *J* may be replaced by a roller for making contact directly with the work instead of with a stationary stop. This arrangement, however, is recommended only when the depth of the recess must be extremely accurate. The tool described can be designed with interchangeable tool-bit holders for machining recesses of different diameters.

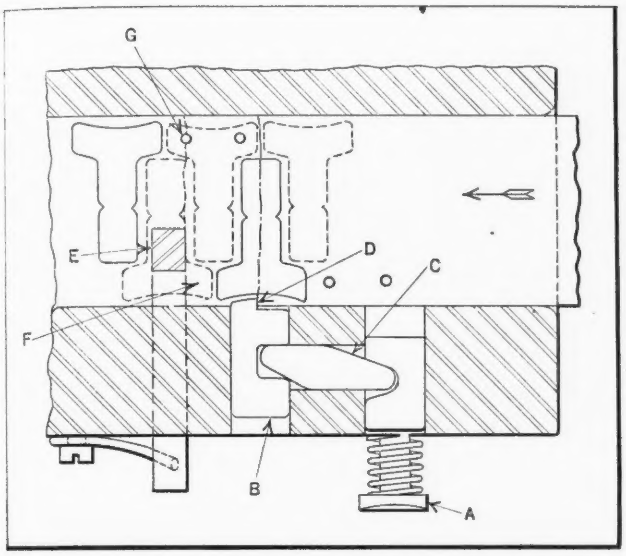
With slight modifications, this idea can be applied to turret tooling for conditions that may not be wholly identical with those shown. D. L. B.

A Fool-Proof Starting Stop for Progressive Dies

By WALTER WELLS, Fort Ann, N. Y.

The desire to design the starting stop for progressive dies as simply as possible has probably been the cause of many piercing punches and pilots being damaged or broken. The usual press-in stop is not actually fool-proof, for if the operator should fail to press the stop just once, allowing the strip to feed past its proper station, damage to a die member is likely to follow.

In the design illustrated, however, the stop is normally in position to stop the strip and must be



Fool-proof Starting Stop for Progressive Dies in which the Operator Must Press the Stop-button to Feed the Strip Past the First Station

pressed to allow the stock to feed to its next station. After passing the starting stop, the movement of the strip is controlled at each stroke of the press by a trigger stop of the usual design. This arrangement has a general application to dies of the progressive type. The slight extra cost of the starting stop is more than offset by the decrease in the cost of repairing damaged dies.

The button *A* is similar to the ordinary stop, with the exception that it does not make contact with the strip. The only additional features are the sliding stop *B* and the rocker arm *C* which oscillates in a slot in the stripper. Both these members are made of 1/8-inch flat stock and hardened at their wearing points. The ends of the arm engage grooves cut in members *A* and *B*, and the movement of the arm is limited by the width of its retaining slot. The gaging point *D* is finished last, in order to avoid unnecessary accuracy in locating members *A* and *B*.

The strip is shown in its starting position against the stop at *D*. Had the strip gone beyond this point or against the trigger stop *E*, the pilot (not shown), which is located at *F* would have been endangered, and the piercing punch at *G* would doubtless have been broken. When the end of the strip has once passed the starting stop, the end of the stop merely rests against the side of the strip with a pressure so slight that it may be disregarded, as it does not interfere with the free feeding of the strip.

Spherical Turning Attachment for Lathe

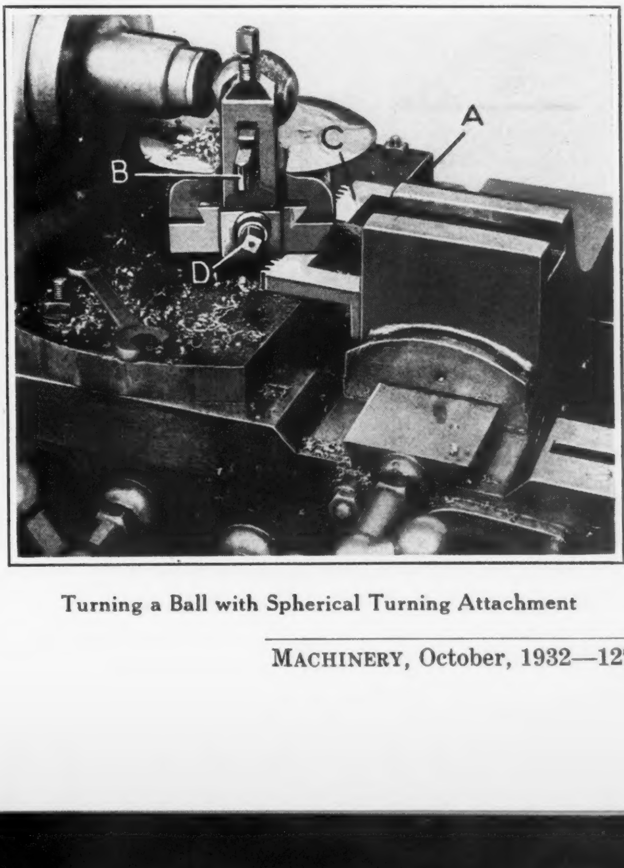
By AVERY E. GRANVILLE, Knox, Ind.

A simple device for turning balls, handwheel rims, and other spherical objects is useful equipment for any shop. Such equipment should be so designed that it can be quickly mounted on the lathe, as is the case with the device shown in the accompanying illustration. This attachment can be made of scrap pieces found around almost any shop. Only a few minutes is required to mount this fixture on a lathe or remove it after it has once been fitted to the lathe. The maximum size ball or other object that can be turned depends on the distance that the end of the cutting tool can be set from the center of the turntable. A turning radius of 3 or 4 inches is more than ample for most requirements, as it will permit the turning of balls up to 6 or 8 inches in diameter. Probably the sizes turned in the average shop will not be greater than 2 or 2 1/2 inches in diameter.

Referring to the illustration, the heavy baseplate *A* is bolted to the saddle of the lathe carriage. On this plate is mounted the turntable that carries the cutting tool. The turntable is pivoted at a point as nearly in line with the center of the lathe spindle as possible, so that the cutting tool *B* will travel in a true circular path about any spherical object held in the lathe chuck or in a special fixture like the one shown.

The base of the turntable has a spur gear attached to its under side, which meshes with a rack *C* bolted to the side of the regular tool-slide. Adjustment of the cutting tool toward or from the work is made by means of screw *D* which works the small slide on the turntable. With this arrangement, movement of the regular lathe cross-slide in either direction will cause the turntable to rotate and the cutting tool to travel in a circular path or arc. Either hand or power feed can be used for the turning operation.

For turning handwheels, means must be provided for setting the center of the turntable away from the center line of the lathe spindle. This can be done by either slotting the baseplate so that the center stud of the turntable may be moved toward the operator or by drilling holes at various distances for the stud. A slot is preferable, as it will permit a wider range of adjustments.



Turning a Ball with Spherical Turning Attachment

Curling and Clinching Die for Securing Flanged Plate to Tube

By H. R. SCHMIDT, Philadelphia, Pa.

The assembling of tube *T* and plate *P*, Fig. 1, is accomplished in the curling and clinching die shown in Fig. 2. The assembling die consists primarily of the punch *D*, pressure pad *E*, and the die member *F*. The hole in the plate *P* is pierced somewhat larger than the outside diameter of the tube so that the end of the tube can be formed to a radius; otherwise, the radius-formed portion of the punch would tend to crush the curled portion of the tube into the edge or sharp corners of the hole in the plate.

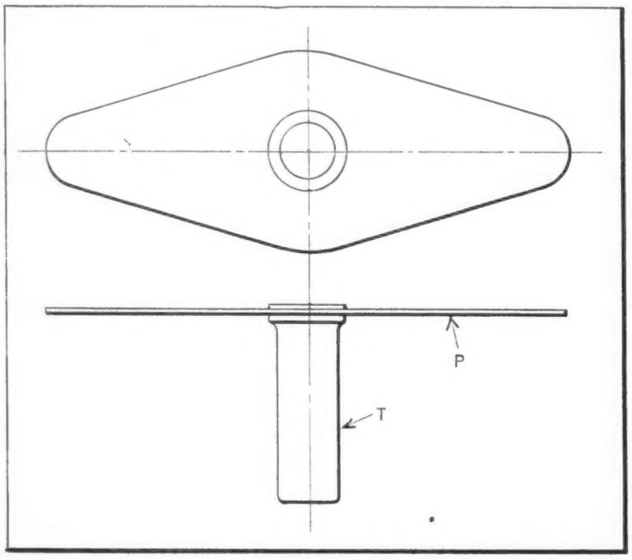


Fig. 1. Tube Assembled to Flange on Die Shown in Fig. 2

In operation, the tube *T* is placed in the die, and the plate *P* put in position over the tube, so that it rests on the pressure pad *E*. The punch, in coming down, curls the upper end of the tube over the plate, as shown at *A*, Fig. 3. Up to this point, there is no movement of the pressure pad *E*, the springs being stiff enough to resist the pressure applied for bending. The punch then carries the pressure pad along with it and completes the bend, as shown at *B* and *C*.

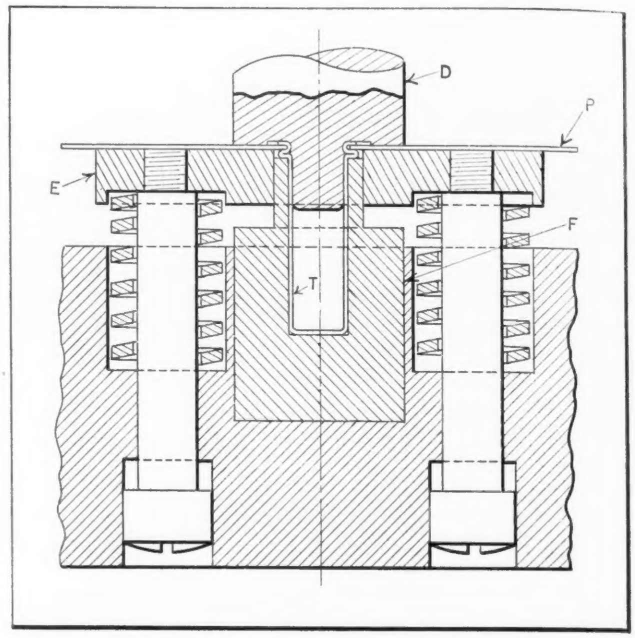


Fig. 2. Die for Curling and Clinching Open End of Tube T, Fig. 1, to Hole in Plate P

* * *

According to the Bureau of the Census, ball and roller bearings were made in fifty-three plants in the United States in 1931. The total value of the ball bearings manufactured was $26,858,000, and of the roller bearings, $20,971,000. The total number of ball bearings exceeded 33,000,000; and of roller bearings, 46,000,000.

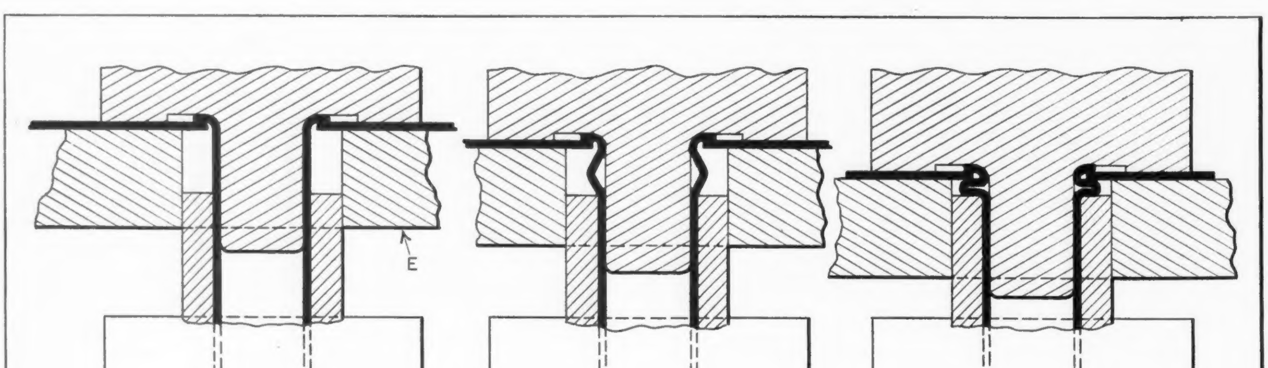


Fig. 3. Three Successive Positions of Punch in Assembling Tube and Flange

Points to Observe in Making Bakelite Molds

A Typical Example of Mold-Making which May be Used as a Guide in Constructing Molds for Various Articles Made from Plastic Materials

By C. B. COLE, President
Tool Equipment Sales Co., Chicago, Ill.

ECONOMY is the first consideration in many industries at present, and in no way is this better exemplified than in the substitution of plastic materials, such as Bakelite, for iron castings and steel stampings. The electrical and radio industries have been largely instrumental in developing this material, due mostly to its insulating qualities and low cost. Today its use has spread to many other fields, so that an almost endless list of articles made from molded plastics could be mentioned. A few of these are shown in Fig. 1.

When light weight is an important factor, plastics offer a real advantage. The two outstanding features of parts made from these materials, however, are the beauty of finish obtained and the fact that practically no machining or finishing operations are required. The actual molding operation produces parts accurately and with a finish equal if not superior to that obtained by polishing and buffing.

It is not the purpose of this article, however, to discuss the various applications of these materials, but to describe the best procedure to follow in the actual making of the molds. For this purpose, a four-cavity mold for telephone boxes will be chosen. Incidentally, this box was formerly made of sheet steel and required four press operations. With the mold to be described, however, four finished Bakelite boxes are produced in one operation at the rate of 6 a minute or 40 an hour. This mold was built by the Service Tool Die & Mfg. Co., Chicago, Ill., for one of the largest telephone companies, and it took about four months to complete it. The mold was designed for use in a 200-ton hydraulic press, and its total weight is approximately 3500 pounds.

Importance of Selecting the Proper Steel for the Die

As a rule, the steels used for Bakelite molds are special alloys. It is important that these steels be capable of withstanding the alternate applications of superheated steam and cold water without changing their shape or size. With ordinary carbon tool steels, distortion is likely to occur, resulting in the loss of accuracy when the mold has been in use but a short time.

Preliminary Operations on the Lower Mold

Both the upper and lower forming members of the mold for the bell ringer box are made in four sections, as shown in Figs. 2 and 4. These sections are secured to their respective bases or grids by

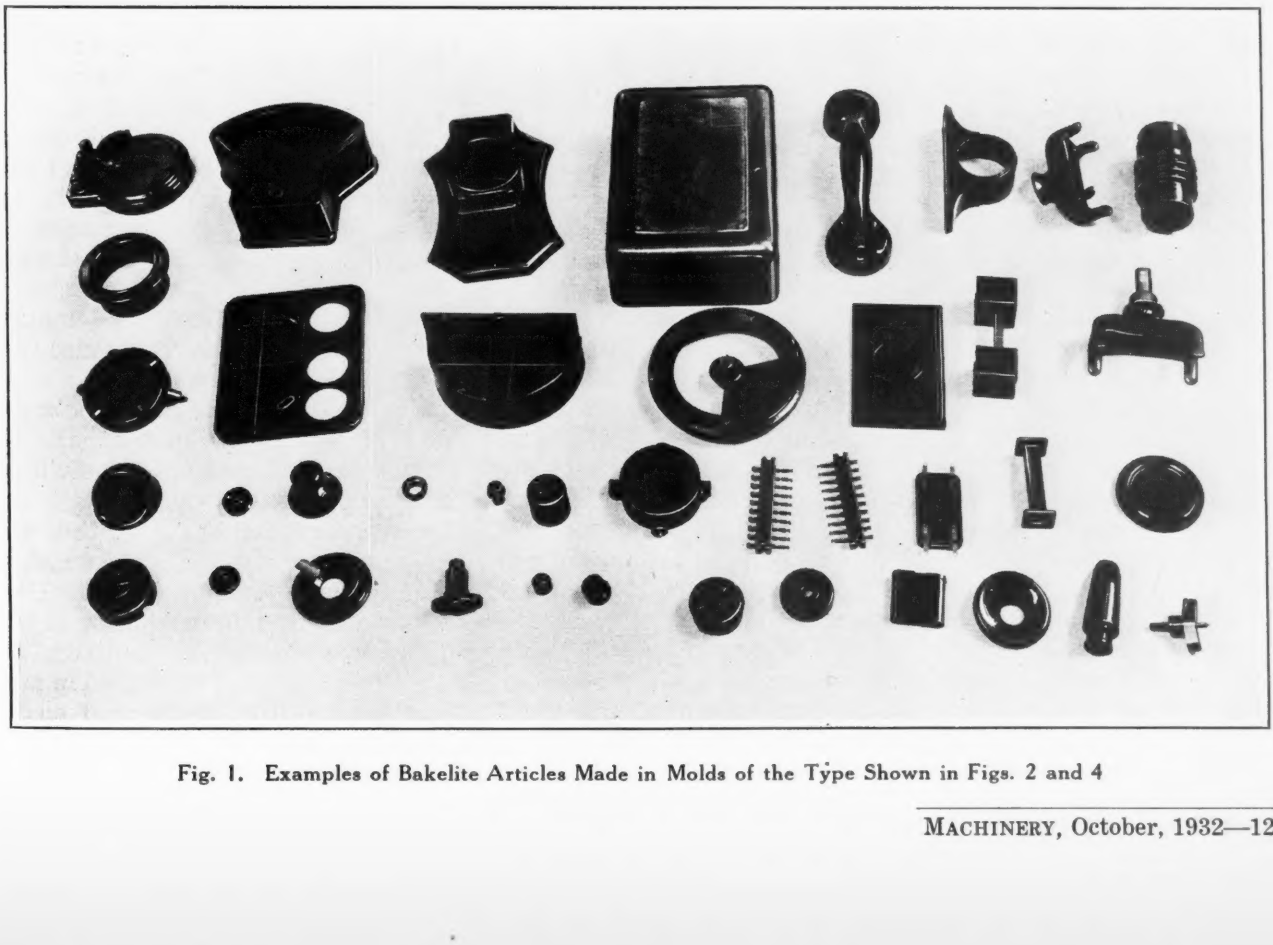


Fig. 1. Examples of Bakelite Articles Made in Molds of the Type Shown in Figs. 2 and 4

hollow hexagon-head cap-screws. The grids are equipped with master leader pins to maintain the alignment of the die members. To further insure alignment of the mating parts, other leader pins are provided with each forming member.

The construction of the lower member, shown in Fig. 2, will be described first. Each section was made from annealed alloy steel, rough-forged to a block weighing over 300 pounds. These blocks were planed square all over and then ground on the top and bottom to obtain a smooth finish. The cavities, leader pin holes, etc., were then laid out on the top ground surface. Following this, the leader pin holes were bored to size in a jig boring machine. The four corners of the cavity were then bored in this machine. This made it possible to machine the contours in the cavity on a vertical die-sinking mill by using various sizes of end-mills and formed cutters. Approximately 0.010 inch was allowed for grinding the contours after hardening.

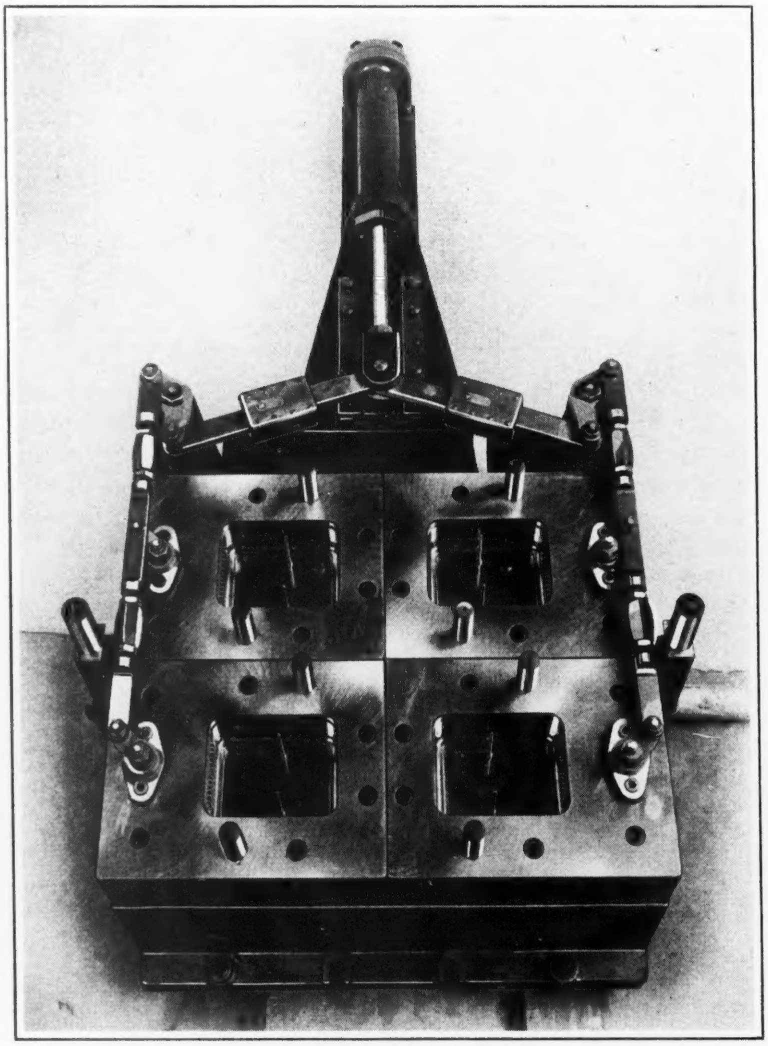


Fig. 2. Four-cavity Lower Mold for a Telephone Ringer Box. All Four Side Formers are Actuated by One Steam Cylinder

Channels are drilled in the mold through which steam is circulated. The heat given off by the steam brings the plastic material to a fluid state while under pressure. The same channels are also utilized for cold water to cool the formed part and bring it to a solid state more rapidly. Owing to the depth of these channels and their close proximity to the cavity surfaces and leader pin holes, unusual precautions must be observed in drilling them. These channels are arranged in a double row, as indicated in the diagram, Fig. 3. Their inlet and outlet openings are tapped for pipe connections and all other openings P are tapped for brass pipe plugs.

After the channels were drilled, one end of each block was drilled out and rectangular openings shaped. These openings serve as guides for the sliding formers operated by a steam cylinder through a series of levers. This construction is shown in Fig. 2.

Precaution to be Observed before Hardening

Before hardening, all forming surfaces were carefully finished. This is very important, because any tool marks or scratches left on these surfaces may prove to be too deep to be ground or polished out after hardening without introducing inaccuracies in the die. Therefore, the final finish obtained before hardening should be inspected carefully. Extra care should be exercised in hardening, because of the very thin walls.

After hardening, the tops and bottoms of the mold sections are ground and polished. This is the final finish, and it determines the kind of surface the product will have. In this case, a very high polish was required. A flexible shaft grinder was used for polishing and several grades of lapping compound were used until the finish had the appearance of a high-luster chromium-plated surface, completely free from scratches.

The machining of the punches or forming sections presented an interesting problem. These also were made from annealed alloy steel, forged into a rough block. To machine these punches to the shape shown in Fig. 4 would mean a lot of scrap if done in the usual way. It was decided, therefore, to drill out the corners of these blocks, and then saw the surplus stock off in a metal band saw. In this way, there was a saving of four pieces of steel weighing 420 pounds and costing 30 cents a pound. These pieces were used on another job. In addition to this, the machining time was reduced substantially.

In general, the same machines were used in making the forming sections that were used on the cavities. Templets were made in order to check the various radii. All important dimensions were held

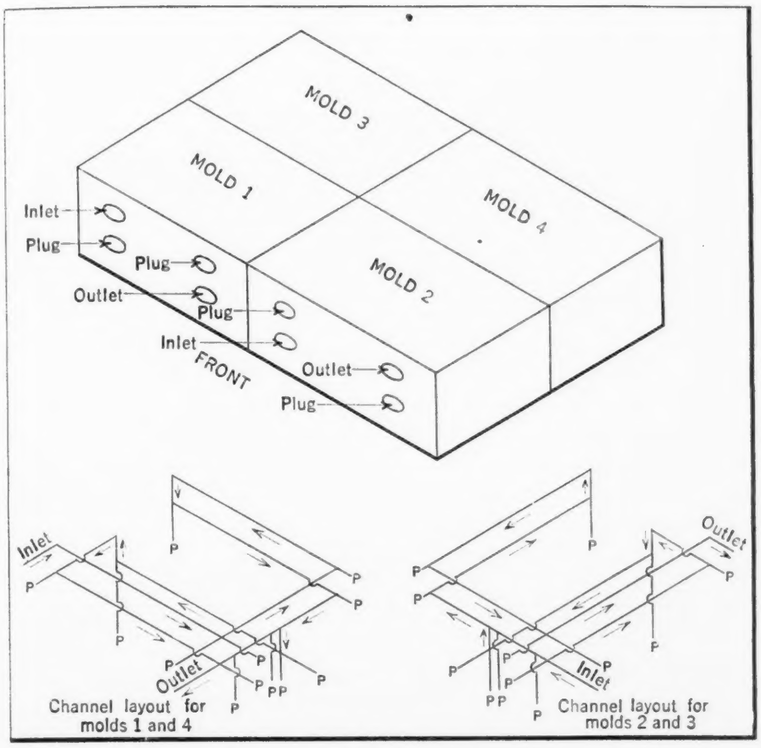


Fig. 3. Diagram Showing the Locations of Channels for Circulating Steam and Cold Water around the Mold

to a tolerance of plus or minus 0.001 inch. This tolerance was made necessary because the formers had to line up with the cavity sections very closely.

Individual strippers are provided for each former, and in addition to this, there is a main stripper mounted inside the upper grid. This stripper automatically removes the finished pieces from the formers. All holes in the main stripper, with the exception of the clearance holes, were bored and counterbored in a jig boring machine to insure accuracy.

The upper and lower grids were planed square, and then all the required holes were carefully drilled and bored on a jig boring machine. In this way, real accuracy could be obtained so as to insure the correct mounting of the various sections and the proper alignment of the main leader pins.

Points on Estimating the Cost of the Molds

The making of Bakelite molds requires specialized knowledge, skill, and equipment. The person who is responsible for quotations on molds of this type in the contract shop should have considerable experience on a wide variety of tool work to enable him to figure prices accurately, particularly when the job must be taken on a definite cost basis. A mistake can easily be made in estimating the amount of work required on tools of this kind. It is next to impossible for the designer to show all the details on a drawing of a complicated mold. In many instances, this class of work should be accepted on a time and material basis only, due to possible errors in design and extra work that cannot be readily determined from the drawings.

* * *

A Record in Quick Shipment of Heavy Machinery

Not all the world's records set in August were made at the Olympic games in Los Angeles. One was made by the General Electric Co. at Schenectady, when the motor-generator department shipped two 10,000-kilowatt waterwheel-driven generators forty-one days after receipt of the order.

The Niagara Falls Power Company required additional 60-cycle generating capacity. At the same time it has an excess of 25-cycle generators. The suggestion was made that it remove two of the 25-cycle machines and obtain two 60-cycle generators to mount on the bed-plates of the old generators. The same waterwheels could, of course, be used to drive the new machines. Since this additional 60-cycle generating capacity was worth several hundred dollars a day to the power company, it was particularly anxious to get the new machines as quickly as possible. The General Electric Co. promised shipment in forty-seven days after receipt of the order. Actually, the two machines, which were special and had to be designed as well as built, left the Schenectady Works forty-one days after the plant had received telephone notification that the order had been placed—that is, six days ahead of the time specified by the customer.

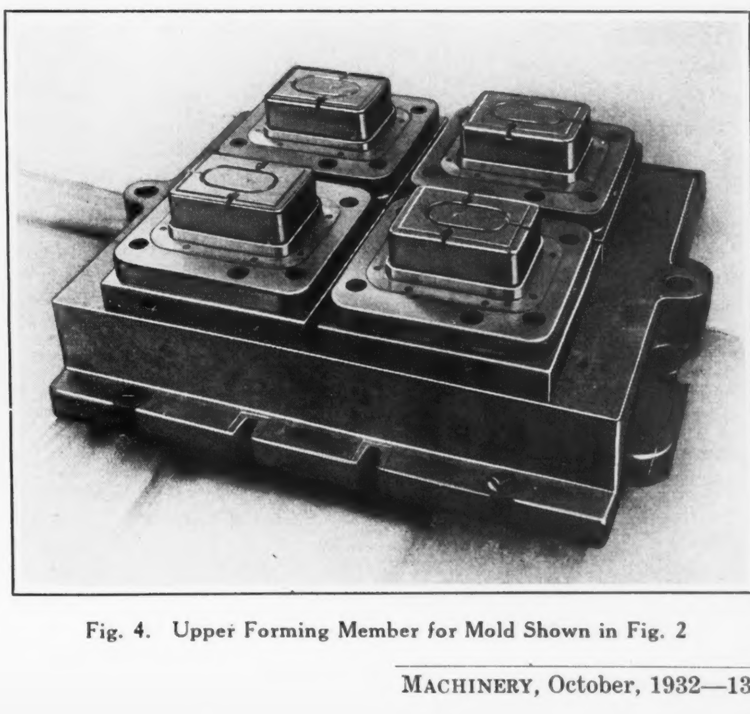


Fig. 4. Upper Forming Member for Mold Shown in Fig. 2

Factors that Influence the Selection of Carburizing Equipment

An Analysis of the Important Points to be Considered in Selecting the Most Suitable Equipment for Economical Operation

By ELMER C. COOK
The American Gas Furnace Co.
Elizabeth, N. J.

IT is hardly possible to weigh or assign percentage values to all the various factors involved in the selection of carburizing equipment. However, a careful consideration of these factors will prove of value to those doing carburizing work, not only when new equipment is contemplated, but also when it is desirable to form a sound opinion on the merits of present equipment. It is the purpose of the present article to enumerate the various factors that should be considered in making the selection.

Types of Furnaces Available for Carburizing

Apart from the method of heating, there are four well defined types of equipment for carburizing. They are (1) the batch-type box-carburizing furnace in which the work is carburized in containers, usually made of heat-resisting alloy; (2) the continuous furnace in which the work is carburized in boxes that are usually pushed through the furnace on heat-resisting alloy rails or rollers (These furnaces include the counter-flow type and the one-directional type.); (3) the rotary horizontal retort carburizing furnace; and (4) the vertical non-rotating retort carburizing furnace.

In the latter two classifications, the carburizing medium is usually gas. Gas is also employed in another type of carburizing equipment recently introduced—the continuous gas-carburizing furnace. The molten-bath method of carburizing is used today only for the smaller parts.

In selecting equipment, one or more of the types mentioned may frequently be eliminated at the outset as unsuitable under the operating conditions. For example, the carburizing may be so extensive that the small box-type furnace would involve too much labor or the parts may be so large that to carburize them in a molten bath would be impracticable. Many parts, again, do not lend themselves to even slow rotation in a rotary carburizing machine. After having considered the possibilities of all the various types of equipment, there usually are a number of feasible types from which the selection can be made.

The factors that must be weighed in making such a selection, broadly speaking, may be classified as tangible and intangible considerations. The tangible considerations are, briefly: (1) The amount of work to be carburized; (2) the accessories necessary; (3) the "stand-by" or spare parts required; (4) the floor space occupied; (5) the subsequent treatment of parts being carburized; (6) the maintenance cost; (7) the cost of containers; (8) the cost of the carburizing medium per pound of work; (9) the cost of labor; (10) the cost of fuel per pound of work carburized; (11) the power cost; (12) the cost of the carburizing equipment itself; and (13) depreciation and interest.

Among the intangible considerations should be mentioned (1) the flexibility of the equipment; (2) the control features; (3) the uniformity of the case obtained; (4) the ease of duplicating the results previously obtained; and (5) the working conditions.

Quantity of Work Usually Determines the Size of Equipment

The first consideration under the tangible factors is the amount of work to be carburized. This is probably the paramount consideration in selecting the equipment, as it determines the size of the equipment. Along with it, the number of hours a day during which the equipment is to be operated must be considered. Twenty-four-hour operation is the most efficient and economical, as it eliminates the non-productive and expensive heating-up period, as well as the unproductive fraction of a day that is a necessary result of partial operation. For example, if a four-hour cycle will give the required case of depth and the balance of the factory operates ten hours a day, two cycles would be all that could be fitted into the day and there would be two hours during which the equipment and the operators would be non-productive.

On the other hand, the equipment should be capable of taking care of peak-production requirements. If, therefore, equipment is purchased on the basis of twenty-four-hour operation, sufficient excess capacity must be allowed, either by increasing the size of one furnace or by adding one more furnace to take care of the extra work.

Importance of Furnace Accessories for Continuous Operation

The accessories to be considered include a number of items. In the case of box furnaces, and continuous furnaces where boxes and compound are employed, they are: (a) An extra set of boxes to permit continuous operation; (b) equipment for handling the compound, including means for riddling and mixing the new compound with the old; (c) a supply of compound and storage room for it; (d) equipment for handling boxes; and (e) quenching equipment.

When gas is employed as the carburizing agent, we require, in the case of rotary machines, quenching equipment; and in some cases, spare retorts. In addition, if vertical carburizers are used, baskets or fixtures for carrying the work are needed. When the operation is on a fairly large scale, a crane, a mechanical hoist, or other device of this character is necessary.

"Stand-by" parts must necessarily be carried to insure continuity of operation. Under the heading of "stand-by parts" must be considered a number of items that involve insurance against shut-down or that will assure a minimum loss of time in an emergency. All kinds of spare parts fall under this classification, including burners in the case of gas- or oil-fired equipment, resistors when electric heat is used, refractories, and spare parts of heat-resisting alloy, as well as boxes, compound, bulk oil, etc.

The importance of floor space depends, to a considerable extent, upon plant conditions. Sometimes floor space is at a premium because of plant congestion. In such plants, it follows that the greater the capacity of the equipment per square foot of floor space required, the more desirable it is.

The uniformity of case obtained on parts being carburized determines to a considerable degree the extent to which warpage in quenching may be avoided. This, in turn, determines the grinding tolerances. Thus, uniformity of case means less warpage and smaller grinding tolerances, and this, in turn, means less grinding equipment and reduced cost of the product. It therefore follows that the more uniform the case of the carburized parts, the lower will be the cost of subsequent operations. Hence carburizing methods have a direct effect on manufacturing costs.

The Effect of Subsequent Treatment on the Selection of Equipment

Both the rotary and the vertical retort type of carburizers are well adapted to any one of a variety of heat-treatments after the actual carburizing operation has been performed. This is not true of some of the other installations which may be difficult to adapt to any other treatment, except the slow cooling of the carburizing boxes. When a double treatment is desired, or when a single quench from the carburizing temperature or slightly below will suffice, it follows that equipment employing boxes is at a disadvantage. Frequently, however, work is quenched directly from the carburizing boxes.

The Various Items of Cost that Must Enter into the Decision

While the cost of any operation is generally given on a cost-per-pound basis, or is quickly converted to this basis from a machine-hour operating-cost figure, the cost of carburizing for purposes of analysis and comparison may best be subdivided and treated under a number of separate headings as follows:

Maintenance Cost—This item includes the cost of maintaining the furnace in proper operating condition and the cost of maintaining accessory equipment in satisfactory workable condition.

Cost of Containers—This item is worthy of close study. With boxes, anywhere from one to three sets a furnace are ordinarily required. The second and even the third set is necessary to insure continuous operation with the pusher type of box furnaces. For the retort type of furnace, we must balance against this item the cost of the retort and, possibly, of a spare retort. The cost of a spare retort can usually be charged against a battery of six or eight machines. Such retorts, as a rule, have longer guaranteed life than the carburizing boxes. Compared with the cost of a number of boxes to give a corresponding capacity in pounds of work carburized, the cost of a retort is usually lower.

Cost of Carburizing Medium per Pound of Work—When boxes are used it is necessary to pack the work carefully in the compound, being certain that the work is not too close to the edges or bottom of the box and that there is an adequate layer of compound above the work; also, that it completely surrounds each individual part being carburized.

Where compound is used in rotary retorts, it is only necessary to throw in a small quantity of it with the work—for example, three to five pounds per 100 pounds of work. When boxes are employed, a ratio of one part of compound, by weight, to as little as three parts, by weight, of work is frequently used. In other words, in figuring the cost of compound for 500 pounds of work, we may assume 100 pounds of compound when boxes are used (on the basis of 40 per cent of new compound being added to the old), compared with not more than 25 pounds of compound when rotary machines are employed.

If gas is the carburizing medium, the usual ratio is about 125 cubic feet of gas per hour to 600 pounds of work. For a 1/32-inch depth of case, three hours carburizing time, with the gas flowing through the retort, would be required. Consequently, the gas consumption would be 375 cubic feet per 600 pounds of work, or about 65 cubic feet per 100 pounds. Actual figures usually show a decidedly lower cost when gas is used in rotary machines.

Cost of Labor—Some of the continuous box-carburizing equipments have been so arranged that the cost of labor is comparatively small. This is accomplished by means of mechanical devices for handling the compound and the boxes, including means for turning the boxes over and vibrating them. The labor cost is usually still lower for rotary or vertical retort machines, where the charge is quickly dumped directly into the retort or placed in a basket which is then put into the retort.

Cost of Fuel—This cost is usually comparatively low for retort equipment, inasmuch as the retort need be heated up only once during a day of ten hours or once a week when the equipment is operated twenty-four hours a day for six days. There

are no boxes or compound to be heated up with each fresh charge of work. The compound, incidentally, acts very much like an insulator. When compound is used in a rotary furnace, there is a comparatively small amount of compound heated, and this is quickly accomplished by the rotation of the retort.

Power Cost—In the case of any fuel-fired furnace, power is required either to supply air under pressure or to boost the gas pressure. It must be borne in mind, however, that the fuel requirement is lower when it is not necessary to heat cold boxes and compound with each new charge of work. In addition to this power cost is the cost of pushing or conveying the work through a continuous furnace. If the furnace is long and the boxes are large, a fairly large motor is required. In the case of rotary furnaces, a one-horsepower motor is adequate to supply power for the slow rotation of the retort.

Cost of Equipment—Now we must consider the various fixed charges. The initial cost of equipment should take into account all accessories, including spare boxes or retorts, cost of compound if used, and a stock of replacement parts. These figures should be compared on a per-pound basis of net weight of work carburized. Such a comparison, also, should consider whether the work is to be immediately quenched, thereby dispensing with one subsequent operation, or whether it must be cooled slowly.

Depreciation and Interest—It is customary to figure the cost of replacement of boxes and retorts separately from the initial investment. Consequently, their cost should be deducted before figuring depreciation. While some plants have special rules for determining the life of the equipment, it is generally considered quite fair to base depreciation figures of carburizing equipment on a ten-year life; unless the equipment is subjected to extremely severe usage, the life will far exceed this estimate. Interest is generally based on 6 per cent a year after amortization of the investment has been allowed for.

To duplicate with certainty the results obtained by heat-treatment can only be done by duplicating, as accurately as possible, all the conditions involved in the heat-treatment operations, including the time, the temperature, and the carburizing medium. If any one of these factors is varied, it will be reflected in the results obtained in the carburized surface. If work is not properly packed in boxes, a variation will be noted. The best process of carburizing is the one in which it is most convenient to duplicate, from day to day, the factors enumerated.

Flexibility of Equipment Essential to Meet Variations in Production Requirements

We have now come to what we have termed the "intangible considerations." Aside from the numerous items on which a dollars-and-cents value can be placed in selecting the type of carburizing equipment to be installed, there are a number of considerations that should, in spite of the fact that it is difficult to weigh them, be given due consideration. Chief among these is flexibility. There are four distinct angles from which this factor should be considered.

1. Flexibility to Meet Production Requirements—If a number of individual furnaces or machines are used, it is possible to shut down some of them when production drops, permitting the required schedule to be maintained without seriously influencing the efficiency of the operation. This is not possible when large continuous furnaces are employed for carburizing a comparatively small volume of work and when a number of "blanks" or empty boxes must be pushed through the furnace and heated. This difficulty is met with frequently in manufacturing plants today, and often the management has concluded that it is cheaper to send the work out to a commercial steel treater than to operate equipment having greater capacity than necessary.

2. Flexibility to Meet Varying Case Requirements—With individual furnaces, any desired case can be obtained by altering the cycle of operation of individual units. This cannot be done in large continuous box-carburizing equipment.

3. Flexibility to Meet Requirements of Subsequent Treatments—With certain classes of equipment, as in the case of rotary and vertical carburizers, it is possible to withdraw the heat after carburizing and to air-cool the treated material, or to quench it either in air or water, or to place it in a pit for slow cooling.

4. Flexibility for Meeting Different Heat-treating Requirements—When there is need for special heat-treatments, including annealing, hardening, carburizing, nitriding, and tempering, the retort type of equipment should be carefully considered. Its versatility may prove of considerable importance in the large factory, manufacturing only a limited number of items on a large scale, as well as in the small plants where the items manufactured may change almost over night, according to the demand.

Under the heading of "control" must be considered the simplicity of maintaining or controlling the furnace temperature, which, of course, includes the method of firing.

Uniformity of Case Will Vary with the Type of Furnace Used

The uniformity of case determines, to a considerable extent, the freedom from warpage in quenching, which, in turn, determines the grinding tolerances. This, again, determines the amount of grinding equipment necessary, and hence has a decided influence on the cost of the product. It therefore follows that the more uniform the carburized parts are, the lower will be the cost of subsequent manufacturing operations, and the lower will be the investment in equipment for these operations. The investment in material in process of manufacture will also be less.

When boxes and compound are used, the compound nearest to the outside of the box and the work near the outside walls of the box are heated first. Carburizing, therefore, commences at these points before it begins at the center of the box. Consequently, the case depth on parts at the center and near the outer edges of the box cannot be the same.

When retorts are employed, the work is first heated to the required temperature. After it has arrived at this temperature, and not before, is the carburizing agent admitted to the retort. Carburizing, therefore, proceeds uniformly on each piece throughout the charge. It is customary, in gas carburizing, to admit, at the time that the charge is placed in the retort, sufficient gas to expell all air; then the gas exit is closed until the entire charge has reached the carburizing temperature. At that time, the proper flow of gas through the retort is started to insure rapid and uniform carburizing.

Uniformity of Heat-Treatment Depends on Ability to Duplicate Operating Conditions

Duplication of results can be obtained only by duplicating, with certainty, all the conditions involved in the operation, including the time, the temperature, and the carburizing medium. If any one of these factors is varied, it will be reflected in the results. If the work is not properly packed in the boxes, a variation will be noted. The process of carburizing that makes the duplication of these factors most convenient will aid in obtaining uniform results.

The effect of the original grain size of the steel upon the process to be chosen for carburizing is a factor to be considered. In the past it has been believed, from a theoretical viewpoint, that it was necessary to quench certain grades of steel from a definite temperature to obtain a fine grain structure. This idea, however, is undergoing some change, because it has been found that the grain size after quenching is dependent, to a considerable extent, upon the initial grain size of the steel. This has an effect upon the question as to whether a double quench after carburizing is necessary or whether a single quench is adequate.

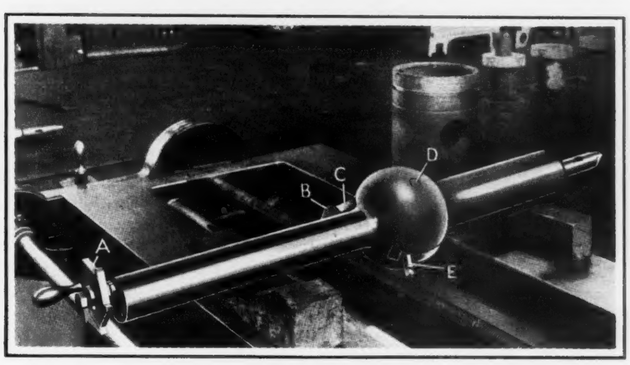
If the initial grain size is sufficiently small, the structure of both the case and the core, after quenching from a carburizing heat of about 1675 degrees F., is found to be satisfactory. In other words, if, in purchasing the steel, a fine grain size is specified, one heat-treating operation may be eliminated. This is particularly true for certain types of gears where the teeth are not subjected to shock but rather to a slow application of the maximum stress. While the grain size may not be so fine in the case as would be obtained by quenching from a lower temperature, it is entirely satisfactory for such service as is required of, say, a spiral gear. In fact, a longer life is obtained than when a double quench is used.

Among the intangible factors, obviously, should be considered also the relation of the carburizing equipment to working conditions. The relative appearance of the equipment has a bearing upon the choice, as well as its convenience of operation, cleanliness, safety, room temperature produced, and all other factors that may have a bearing upon the operator's efficiency.

Bar for Boring Large Ball Sockets

By AVERY E. GRANVILLE

A bar for boring very large ball sockets is shown in the illustration. It has a taper shank at one end which fits the spindle of a 36-inch lathe. The other end is supported in a steadyrest. In use, the bar extends through the ball socket, which is held in a special fixture. A ratchet wheel *A* is keyed to the outer end of a feed-screw, which is offset in the bar. For each revolution of the bar, a tooth in the ratchet wheel engages a fixed pin, giving the feed-screw a partial revolution. The screw, in turn, operates a nut *B* having a slotted projecting boss to which one end of a connecting-rod *C* is hinged. Connecting-rod *C* is hinged at the other end to a tool-holder pivoted on the pin *D*.



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With this arrangement, rotation of the boring-bar will cause the cutter *E*, secured in the tool-holder, to be fed around pin *D* and machine the spherical bore. A handle on the ratchet wheel provides a means for returning the cutter to its starting position. Although this tool was designed for heavy work, the same principle can be applied to lighter jobs, and with slight modifications may be made to suit numerous other internal machining jobs of a similar character.

are no boxes or compound to be heated up with each fresh charge of work. The compound, incidentally, acts very much like an insulator. When compound is used in a rotary furnace, there is a comparatively small amount of compound heated, and this is quickly accomplished by the rotation of the retort.

Power Cost—In the case of any fuel-fired furnace, power is required either to supply air under pressure or to boost the gas pressure. It must be borne in mind, however, that the fuel requirement is lower when it is not necessary to heat cold boxes and compound with each new charge of work. In addition to this power cost is the cost of pushing or conveying the work through a continuous furnace. If the furnace is long and the boxes are large, a fairly large motor is required. In the case of rotary furnaces, a one-horsepower motor is adequate to supply power for the slow rotation of the retort.

Cost of Equipment—Now we must consider the various fixed charges. The initial cost of equipment should take into account all accessories, including spare boxes or retorts, cost of compound if used, and a stock of replacement parts. These figures should be compared on a per-pound basis of net weight of work carburized. Such a comparison, also, should consider whether the work is to be immediately quenched, thereby dispensing with one subsequent operation, or whether it must be cooled slowly.

To duplicate with certainty the results obtained by heat-treatment can only be done by duplicating, as accurately as possible, all the conditions involved in the heat-treatment operations, including the time, the temperature, and the carburizing medium. If any one of these factors is varied, it will be reflected in the results obtained in the carburized surface. If work is not properly packed in boxes, a variation will be noted. The best process of carburizing is the one in which it is most convenient to duplicate, from day to day, the factors enumerated.

Depreciation and Interest—It is customary to figure the cost of replacement of boxes and retorts separately from the initial investment. Consequently, their cost should be deducted before figuring depreciation. While some plants have special rules for determining the life of the equipment, it is generally considered quite fair to base depreciation figures of carburizing equipment on a ten-year life; unless the equipment is subjected to extremely severe usage, the life will far exceed this estimate. Interest is generally based on 6 per cent a year after amortization of the investment has been allowed for.

Flexibility of Equipment Essential to Meet Variations in Production Requirements

We have now come to what we have termed the "intangible considerations." Aside from the numerous items on which a dollars-and-cents value can be placed in selecting the type of carburizing equipment to be installed, there are a number of considerations that should, in spite of the fact that it is difficult to weigh them, be given due consideration. Chief among these is flexibility. There are four distinct angles from which this factor should be considered.

1. *Flexibility to Meet Production Requirements*—If a number of individual furnaces or machines are used, it is possible to shut down some of them when production drops, permitting the required schedule to be maintained without seriously influencing the efficiency of the operation. This is not possible when large continuous furnaces are employed for carburizing a comparatively small volume of work and when a number of "blanks" or empty boxes must be pushed through the furnace and heated. This difficulty is met with frequently in manufacturing plants today, and often the management has concluded that it is cheaper to send the work out to a commercial steel treater than to operate equipment having greater capacity than necessary.

2. *Flexibility to Meet Varying Case Requirements*—With individual furnaces, any desired case can be obtained by altering the cycle of operation of individual units. This cannot be done in large continuous box-carburizing equipment.

3. *Flexibility to Meet Requirements of Subsequent Treatments*—With certain classes of equipment, as in the case of rotary and vertical carburizers, it is possible to withdraw the heat after carburizing and to air-cool the treated material, or to quench it either in air or water, or to place it in a pit for slow cooling.

4. *Flexibility for Meeting Different Heat-treating Requirements*—When there is need for special heat-treatments, including annealing, hardening, carburizing, nitriding, and tempering, the retort type of equipment should be carefully considered. Its versatility may prove of considerable importance in the large factory, manufacturing only a limited number of items on a large scale, as well as in the small plants where the items manufactured may change almost over night, according to the demand.

Under the heading of "control" must be considered the simplicity of maintaining or controlling the furnace temperature, which, of course, includes the method of firing.

Uniformity of Case Will Vary with the Type of Furnace Used

The uniformity of case determines, to a considerable extent, the freedom from warpage in quenching, which, in turn, determines the grinding tolerances. This, again, determines the amount of grinding equipment necessary, and hence has a decided influence on the cost of the product. It therefore follows that the more uniform the carburized parts are, the lower will be the cost of subsequent manufacturing operations, and the lower will be the investment in equipment for these operations. The investment in material in process of manufacture will also be less.

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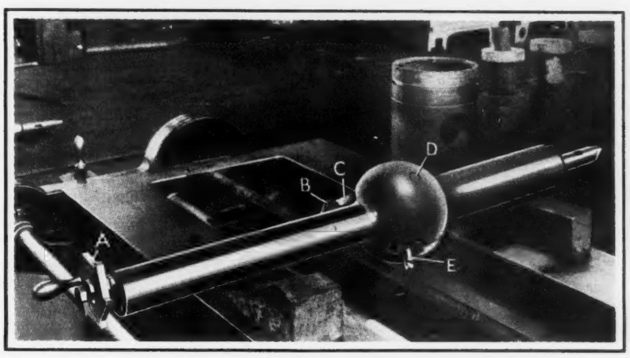

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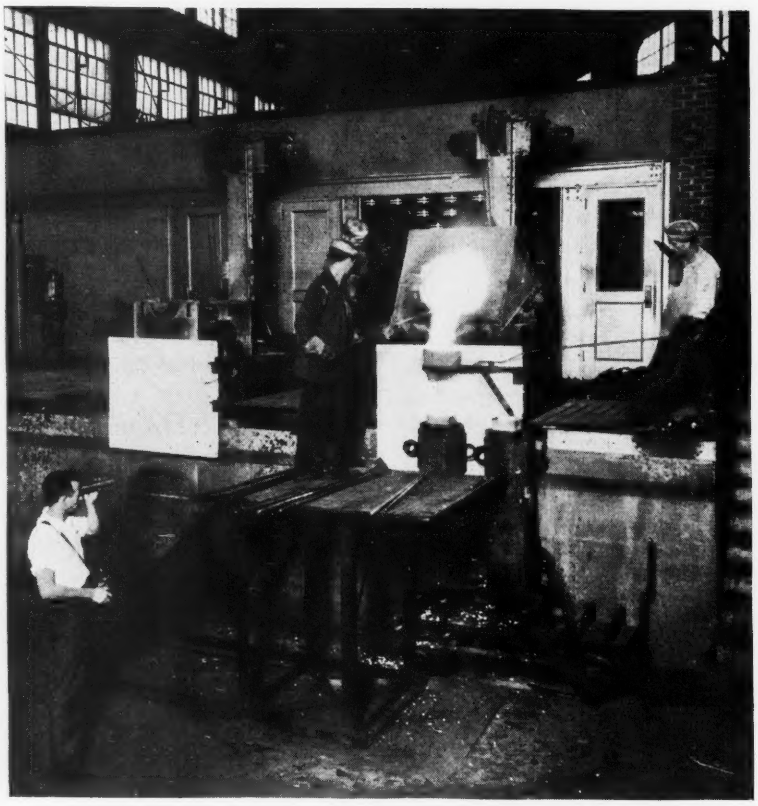
A New Free-Cutting Stainless Steel



By Using Small Percentages of Selenium in Stainless Steel, the Carpenter Steel Co. has Succeeded in Making an Entirely New Brand of Easily Machined Material

MOST engineers believe that the chemical elements that can advantageously be used in iron and steel metallurgy have been experimented with for years. Hence, the use of an entirely new element to improve the properties of an iron and steel product constitutes real news.

This is the news that comes from Reading, Pa., where the Carpenter Steel Co. has succeeded in applying selenium to stainless steel to produce a free-machining metal. Selenium has proved to be fully equal to sulphur as a free-cutting agent; at the same time, it is free from some of the disadvantages that arise from the use of a high sulphur content.

Selenium is a non-metallic chemical element which has been known to science since 1817. Its principal use up to the present has been in electrical devices, because it possesses the peculiar property of having an electrical conductivity depending upon the amount of light to which it is subjected. In darkness, the electrical resistance of selenium is very high. When it is exposed to light, the conductivity is increased from 15 to 100 per cent. The high conductivity is lost as soon as the light source is removed. This peculiar property makes it possible to pass an electric current through a selenium coil and make this current vary by changing the amount of light to which the coil is exposed—the more light, the more current. As far as is known, however, selenium has never before been used as an alloying element in iron or steel, and its application for creating a free-machining metal appears to be entirely new.

The first commercial use of selenium stainless steel was in connection with a free-machining 18-8 steel known as "Carpenter Stainless Steel No. 8," which contains approximately 18 per cent chromium, 9 per cent nickel, and 0.25 per cent selenium. When this 18-8 free-machining steel was first announced by the Carpenter Steel Co. a few months ago, it contained about 0.30 per cent sulphur as the free-cutting agent. The sulphur has now been replaced by selenium, with considerably improved results. Experiments indicate that the free-machining qualities are proportional to the total selenium content. The finished product is much tougher and has less tendency to transverse fracture. In transverse tests, selenium steels have about one-third greater elongation and reduction of area and twice the Izod impact resistance of the sulphur stainless steels. The ultimate strength is the same.

High-sulphur 18-8 steel is not suitable for use in the form of sheets or strip, because it will stand practically no longitudinal bending or deep drawing. The selenium steels can be used for some of these purposes. For any parts subjected to internal bursting strain or transverse shock, the selenium steels are superior (safer) than those having a high-sulphur content. From a corrosion-resisting standpoint, selenium steel also has some advantages.

Selenium stainless steel is so freely machineable that it can be cut in automatic screw machines at from 60 to 70 per cent of the speed used for ordinary Bessemer screw stock. It can be drilled, tapped, threaded, and machined generally with ordinary machine shop tools and methods. Those who have tried to drill, tap, or thread the regular types of 18-8 stainless steel will appreciate what this means in economic production.

Grinding Properties of the New Selenium Stainless Steel

A number of tests were made by the Carborundum Co., Niagara Falls, N. Y., in collaboration with the Carpenter Steel Co., to determine whether selenium, like sulphur, improves the grinding properties of 18-8 steel.

Grinding difficulties in handling stainless steels arise from the fact that the chips adhere tightly to the wheel. A wheel thus loaded with chips cuts with low efficiency and produces more heat than useful work. A high-sulphur content in the steel is very effective in keeping the wheel free from loading, decreasing the heat produced and increasing the speed of cutting.

The experiments were undertaken with a view to learning if selenium has a similar action in grinding operations. The tests were very carefully conducted and recorded, care being taken to insure identical conditions in the testing of the different grades of steel. The grinding properties were determined by dividing the weight of metal removed by the loss in weight of the wheel. This gives a figure for "wheel efficiency" in terms of unit weights of metal removed per unit weight of abrasive.

Four different kinds of steel were tested: (1) Stainless No. 4, an 18-8 chrome-nickel steel, containing low sulphur and no selenium; (2) stainless No. 8, of the same base analysis, but containing low sulphur and 0.25 per cent selenium; (3) stainless No. 1, containing 14 per cent chromium but no nickel, low in sulphur, and no selenium; (4) stainless No. 5, likewise a 14 per cent chromium iron, but high in sulphur, with no selenium, and considered an ideal stainless steel for rapid grinding and polishing, as evidenced by the tests made.

The results were carefully charted, and showed that selenium effects an improvement in the grinding qualities of the 18-8 stainless steel equal in degree to the improvement effected by sulphur on a straight chromium steel. The grinding efficiency in both cases is between *eight and nine times* that for stainless steel low in sulphur or without selenium.

Equally satisfactory results have been obtained in tests that involved other machining operations.

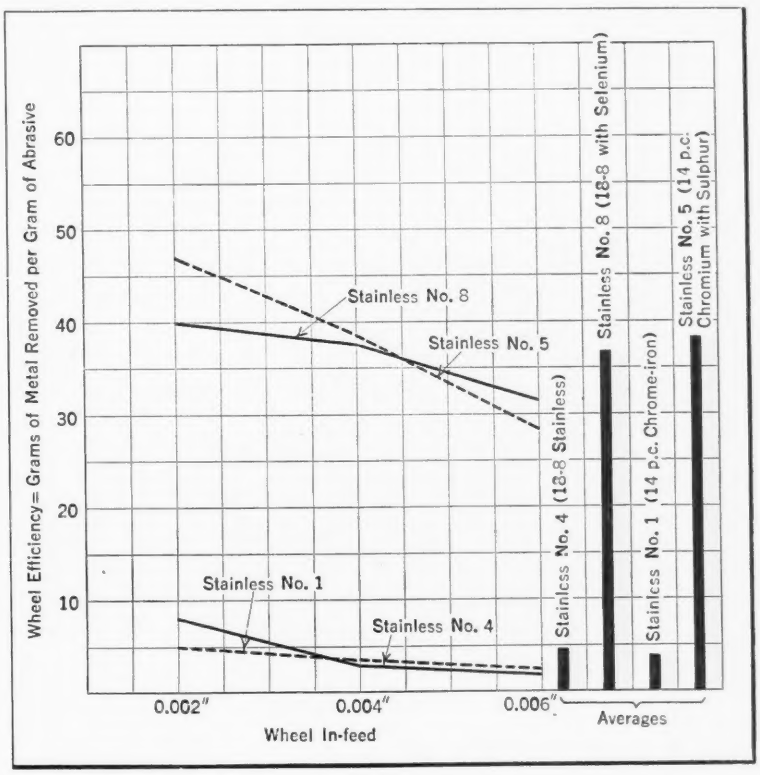


Chart Showing Effect of Selenium and Sulphur on Grinding Properties of Stainless Steel

British Standards for Machine-Cut Gears

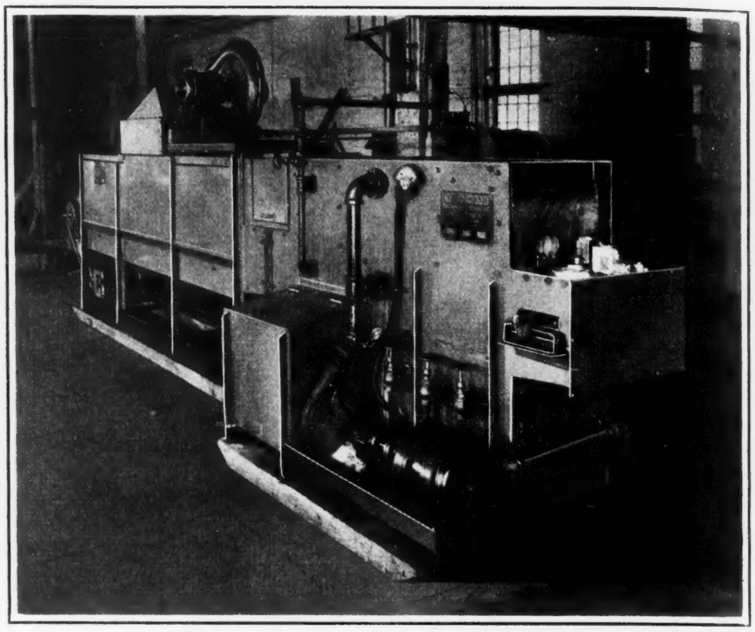
A specification for helical and straight spur machine-cut gears has recently been issued by the British Standards Institution. This contains a great deal of information on the design and strength of industrial gears. The specification deals with machine-cut gears connecting parallel shafts, the teeth being either straight, single-helical, or double-helical, and of the 20-degree, full-depth involute system. It covers the following three classes: Class A includes precision-ground or cut gears suitable for peripheral speeds exceeding 2000 feet per minute; Class B, high-class cut gears suitable for peripheral speeds between 750 and 3000 feet per minute; Class C, commercial cut gears suitable for peripheral speeds below 1200 feet per minute.

In addition to dealing with the form of gear teeth, clearance, maximum permissible pitch errors and tolerances, the specification lays down standard formulas for the strength and rating of gears and includes a series of charts showing at a glance the proportions of gears of different materials. The next section of the gearing specifications to be taken in hand will be that dealing with bevel and spiral gearing. Copies of the specification may be obtained from the Publication Department of the British Standards Institution, 28 Victoria St., London, S. W. 1, England, at the price of 5/6.

* * *

Among the recent investigations undertaken at the National Physical Laboratory at Teddington, near London, England, were experiments with crude lanoline, a waste product of the woolen industry, which has been proved to be a very satisfactory coating for the preservation of bright steel surfaces. It is claimed to be more efficient and less expensive than petroleum grease. Test pieces stored in the corrosive atmosphere of a store-shed for ammonium nitrate have withstood corrosion for three years, while pieces protected by mineral oil rusted in from one to six months.

Engineering Metal-Washing Jobs



How a Manufacturer of Metal-washing Machines Analyzes Cleaning Problems and Builds Equipment to Meet the Requirements

By F. C. DUSTON

THE tendency of the present day is toward more frequent and more thorough cleaning of metal parts during the process of manufacture. The old-time cleaning tank with its fire and health hazards cannot meet the many metal-cleaning requirements of an up-to-date plant and is being rapidly replaced by power-operated washing machines and improved cleaning tanks. Many large plants are now so thoroughly equipped in this respect that every important metal-cleaning job is performed as precisely as any machining operation. Smooth-working metal-washing installations of this kind, however, are generally the result of considerable experimental work and careful planning by engineers who have specialized in the design of metal-washing machines.

So many variable factors are involved in metal cleaning that nearly every job presents an individual or separate problem. Thus, most manufacturers have come to consider the planning and installation of metal-cleaning equipment as a job for engineers who specialize in such work.

The procedure followed by the Metalwash Machinery Co., Inc., 117 E. 24th St., New York City, in making installations of this kind, is described in the present article. This company has been designing and building metal-washing equipment for the last seven years, and has developed various types of metal-cleaning machines to meet the requirements of the machine-building industries.

Outline of Data Required in Planning Equipment for a Metal-Washing Job

The following is a brief outline of the data required by the Metalwash Machinery Co. for the preliminary lay-out of equipment for a typical metal-washing job:

1. The substances that are to be removed from the parts to be cleaned. Oil, chips, paint, grit, and even finger marks are some of the substances commonly removed by metal-washing machines.

2. The nature of the previous and subsequent operations, and the method of handling the work, that is, in baskets, or by flat or rail conveyors. The latter information is needed to eliminate manual operations as far as possible.

3. The kind of material from which the work is made. Brass, steel, alloys, tin, etc., require different treatments. A cleaning solution of caustic soda, for example, could not be used for tin articles, because it has a tendency to flake the tin.

4. Quantity of material to be washed per day or week.

5. Maximum and minimum sizes of work to be cleaned, where several different parts are to be handled. This must be known in order to equip the washing machine with a conveyor that will handle both the larger and the smaller pieces. When possible, it is desirable to have samples of the work to be cleaned.

6. Space available for the washing equipment. In the manufacture of certain products, it may be necessary to subject the work to frequent cleaning operations. These operations may consist of washing, rinsing, drying, and oil-slushing, and may require a machine body 50 to 75 feet in length. Often it is necessary to make the machine more compact by using the return-type construction. The overhead clearance and the elevator capacity must also be known in order to so design the equipment that it can be easily installed.

Washing operations are not always necessary where specified on the original production plans. For example, it may be profitable or more economical to run the work through a spray that will give it a temporary rustproofing instead of giving the work a thorough cleaning. In the case of an engine-building plant, for example, it was found more desirable to run the cylinder blocks through a rustproofing spray after a certain operation than to give the blocks a thorough cleaning.

7. Facilities available for operating the washing

machine equipment, that is, what electric power is available; what equipment is available for furnishing steam for heating and drying purposes; and, if steam is not available, whether the plant is equipped with gas lines, or whether electric heating would be preferred.

When the data indicated in the preceding outline have been obtained, the engineer can determine the equipment required. Naturally, many identical or similar metal-washing jobs are encountered, and the machines developed for such jobs come to be considered as standard. However, almost all cleaning jobs of any considerable size require different equipment or a different arrangement of similar equipment.

Method of Testing Efficiency of Proposed Equipment

Two companies manufacturing the same product may require entirely different metal-cleaning equipment due to differences in available floor space, method of handling, and manufacturing procedure. After a rough lay-out of the proposed cleaning equipment has been made, samples of the work, if available, are put through test machines operating according to the preliminary lay-out. When the work is cleaned satisfactorily on the test machines, the construction of the proposed equipment can proceed with the assurance that it will meet requirements.

The broad experience of the engineer who makes the preliminary lay-outs enables him to predetermine quite accurately what equipment will be required for all ordinary cleaning jobs. When a job presents unusual difficulties, it may require more or less experimental work on the test machines. In such cases, different cleaning compounds may be tried out, the test machines may be adjusted to deliver sprays at different angles, temperatures, or pressures, and other variable factors may be adjusted until the desired results are obtained. Obviously, this experimental work can be economically carried out only by engineers who are experienced in such work and have available the various types of washing, rinsing, and drying machines designed for such tests.

Types of Machines Used for Metal Cleaning

The following is a list of the major types of metal-cleaning machines now in general use:

1. The flat conveyor-type washing machine, which is perhaps the one in most common use. Machines of this type have conveyors made of flight bars, chains, wire mesh, and rollers for carrying the work through the cleaning, rinsing, and drying chambers. Such machines are made in units that can be assembled so that the work can be carried continuously through a series of hot and cold washing, rinsing, and drying operations arranged in any desired sequence.

2. The overhead conveyor-type metal-cleaning machine. This machine has overhead traveling chains from which the work is suspended. Either the washing machine is built around the product-conveyor system or the washing machine is equipped with its own conveyor system.

3. The rotary cleaning machine. This type consists of a perforated cylinder or barrel with a helical screw welded or fastened to its inner surface. When the barrel is rotated, this screw conveys the materials past the cleaning sprays and the blasts of hot air used for drying. The length and drum diameter of the rotary-type machine depends on the quantity of material to be cleaned, as well as on the maximum size piece. Machines of this type are particularly well adapted for cleaning small screw machine parts and similar work.

5. The centrifugal-type metal-cleaning machine. This consists essentially of a high-speed rotor for holding the work. The rotor is so designed that the material is first subjected to a spray, after which the cleaning compound is thrown off by centrifugal force.

Do You Know

that nickel-steel forgings are commercially turned with cutting speeds up to 225 feet per minute?—see page 83.

what precautions to observe in making molds for plastic materials?—see page 129.

what effect the use of selenium in stainless steel has upon the metal?—see page 136.

how to select washing and cleaning equipment for metal parts?—see page 138.

to what extent roller bearings have been successful for locomotives?—see page 102.

what points to consider in selecting carburizing equipment to meet varying manufacturing needs?—see page 132.

Better Production Control by a New Method

The Use of the Chronolog Enables Management to Obtain a Graphic Record of Machine Performance and the Reasons for Production Delays

THE elimination of idle time—both of men and machines—is the road to profits in many industrial plants. How to determine the amount of idle time and the reasons for it is the primary problem.

This information, so far as any machine or operation subject to interruption is concerned, can be obtained through a device known as the Chronolog, which is manufactured by the National Acme Co., Cleveland, Ohio. With this instrument, a constant graphic record of the productive and idle time of a machine is produced, and, in addition, the service given to the machine by everyone who is responsible for its operation is shown.

Fig. 1. The Chronolog—an Instrument that Gives a Graphic Record of Machine Performance and of the Work Done by Inspectors, Assemblers, and Others Engaged in Tasks Subject to Interruption

Hence, the Chronolog gives the management of an industrial plant the means of keeping in close contact with any machine, operation, inspection, etc. It exposes unnecessary delays and places the blame where it belongs. On the other hand, it should enable machine operators to earn more money by revealing causes for idle time that can be eliminated. With this device, the foreman can keep a closer check on both productive and non-productive labor under his supervision.

In the metal-working field, the Chronolog is applicable to every kind of machine tool, as well as to punch presses, and can be used in connection with welding, assembling, and similar operations. Fig. 2 shows this device applied to a Sundstrand stub lathe, while the heading illustration shows it keeping close tabs on an inspection operation.

When the operator of a machine equipped with this instrument starts work, he inserts a key into a slot in the device and turns on a switch. His key remains in this slot until the day's work is ended. The Chronolog prints the time to the minute on a paper roll when the key is inserted and records the fact that the indicators, which may be seen in Fig. 1, have been set to zero. At fixed intervals from that time on are printed the clock time, the cause for idle time if the machine is idle, the accumulated idle time, the accumulated production time, and the total number of pieces produced to the minute recorded. By a simple adjustment, the printing intervals can be made five, ten, fifteen, or thirty minutes, to suit the requirements of the work.

As the indicators are plainly visible, the operator can glance at them from time to time to see how the number of idle and productive minutes compare. This gives him an idea of his earnings up to that point, and so the indicators are of value in drawing his attention to an unsatisfactory showing during the working day, before it is too late to do something about it.

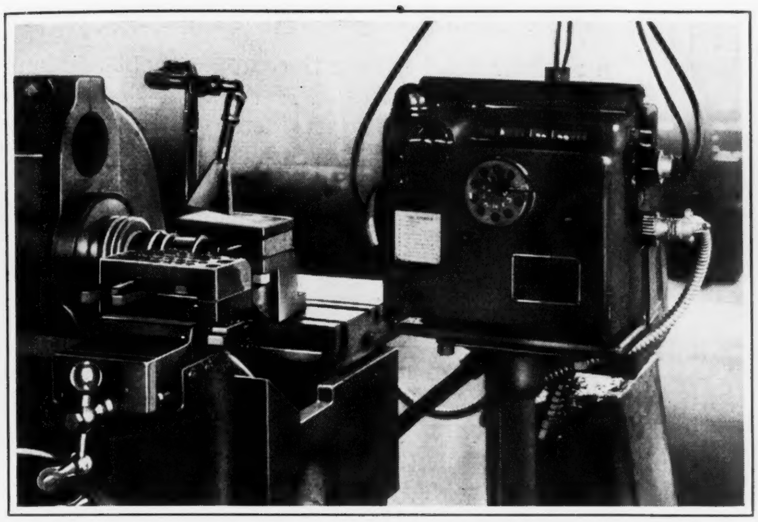


Fig. 2. In the Metal-working Field, the Chronolog is Applicable to Many Types of Machine Tools and Other Machinery

Whenever the machine is stopped, the operator dials a letter that indicates the cause, and thus the reason for the delay is recorded on the paper roll. Ten letters appear on a dial which is on the front of the instrument case. On an automatic screw machine installation, these letters would have the following meanings: P, production; A, personal; E, down for stock; J, inspection; H, cleaning machine; M, tool grinding; T, machine repair; X, no job; Z, busy on other machine; and S, set-up.

When an operator dials any letter, a signal lamp warns the foreman that the machine is idle. The Chronolog prints the time, to the minute, at which the interruption started, as well as the symbol indicating the reason, and starts to add up idle minutes instead of productive minutes. This continues until the man is ready to resume the operation of the machine. He then pushes a reset button, which brings the dial back to the letter P, indicating that the machine is again in production. Should the operator neglect to push the reset button, the first piece of work produced will automatically set the dial to the letter P, unless it happens to be set at S. Since pieces produced during a set-up time are imperfect, they are not counted and they do not automatically set the dial to indicate production.

If a machine keeps running without producing pieces, due to the fact that there is no stock or because of some similar reason, the signal light will flash on and off and attract the attention of the operator. This feature is especially valuable in the case of hopper-fed automatic machines, where the contents of the hopper cannot easily be seen.

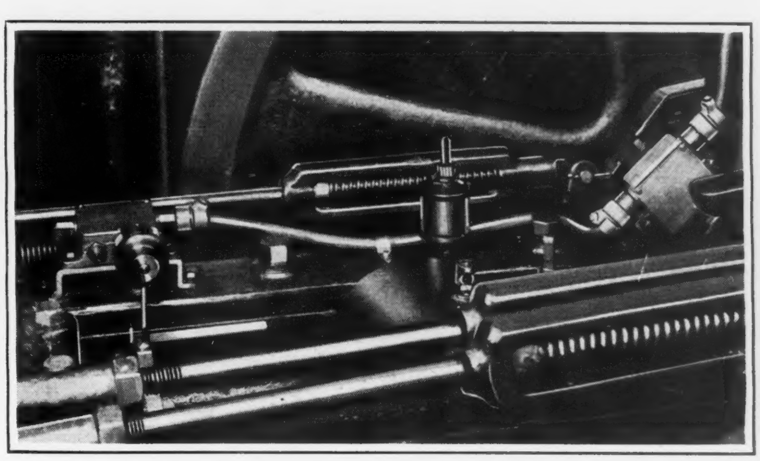
Fig. 3 shows an installation of this sort on a bolt-trimming machine. The switch at the right-hand end of the illustration flashes a light when the hopper is empty. There is an oscillating switch at the left that counts the number of pieces produced. Both these switches are connected to a Chronolog that stands on a pedestal adjacent to the machine.

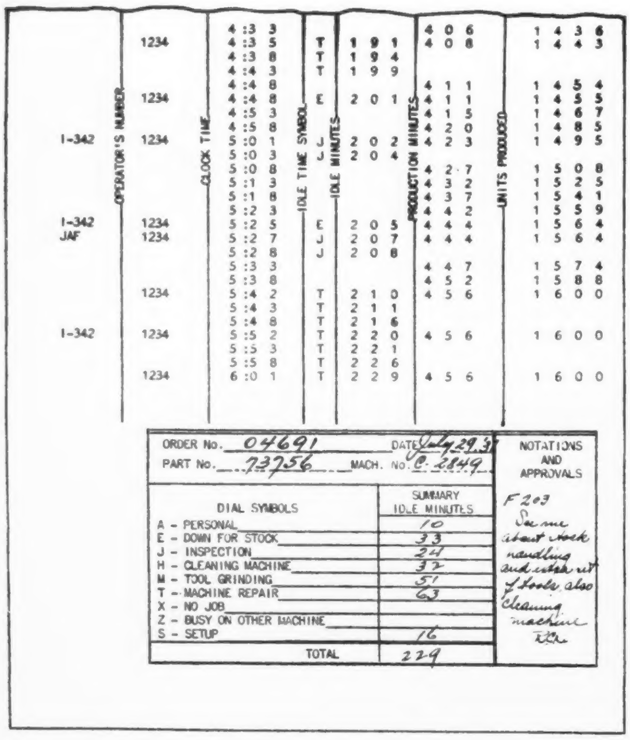
Fig. 4 shows the final portion of a record made by a Chronolog mounted on an automatic screw machine. Only the details of operation are given from 4:33 to 6:01 o'clock; but the total idle minutes, production minutes, and number of units produced appear in the fifth, sixth, and seventh columns, respectively. The first column at the left shows that inspector No. 1-342 had the machine stopped several times between 5:01 and 6:01 o'clock. This column also shows that the foreman whose initials are J. A. F., was at the machine at 5:27 o'clock. It will be seen that the total number of idle minutes was 229, the total number of production minutes, 456, and the total number of pieces produced, 1600. The time, 6:01 o'clock, was recorded automatically when the operator removed his key.

When the time clerk removes the record at the end of the day, he stamps a form for the summary at the bottom of the record, as shown in Fig. 4. He then totals the idle time for each cause. When the tabulation shows excessive idle time for any reason, the foreman or superintendent can readily refer to the body of the record to determine the length of each interruption and just when it occurred.

Fig. 5 shows both sides of the Chronocard which is intended to be given to the payroll, production, time study, and other departments requiring an explicit record of the progress made by the machine. The entries at the top of the "In" side of this card are made by the time clerk after he removes the record of a day's run and clears the Chronolog for the next day. The entries on the

Fig. 3. One Switch on this Bolt-trimming Machine Flashes a Red Light When the Hopper is Empty, while Another Causes the Chronolog to Register the Number of Parts Trimmed





	Operator's Number	Clock Time	Idle Time Symbol	Idle Minutes	Production Minutes	Units Produced
		4:33			406	1436
	1234	4:35	T	191	408	1443
		4:38	T	194		
		4:43	T	199		
		4:48			411	1454
	1234	4:48	E	201	411	1455
		4:53			415	1467
		4:58			420	1485
1-342	1234	5:01	J	202	423	1495
		5:03	J	204		
		5:08			427	1508
		5:13			432	1525
		5:18			437	1541
		5:23			442	1559
1-342	1234	5:25	E	205	444	1564
JAF	1234	5:27	J	207	444	1564
		5:28	J	208		
		5:33			447	1574
		5:38			452	1588
	1234	5:42	T	210	456	1600
		5:43	T	211		
		5:48	T	216		
1-342	1234	5:52	T	220	456	1600
		5:53	T	221		
		5:58	T	226		
	1234	6:01	T	229	456	1600

ORDER No. 04691 DATE July 29 '31
PART No. 73756 MACH. No. C-2849

DIAL SYMBOLS	SUMMARY IDLE MINUTES
A - PERSONAL	10
E - DOWN FOR STOCK	33
J - INSPECTION	24
H - CLEANING MACHINE	32
M - TOOL GRINDING	51
T - MACHINE REPAIR	63
X - NO JOB	
Z - BUSY ON OTHER MACHINE	
S - SETUP	16
TOTAL	229

NOTATIONS AND APPROVALS
F 203
See me about stock handling and check set of tools also cleaning machine etc.

Fig. 4. The Final Portion of a Day's Record (called the "Chronorecord") Taken from a Chronolog. The Form at the Bottom is Stamped and the Summary Made by the Time Clerk

"Out" side are made at the end of the next day's run. These entries are stamped by slipping the card into a slot on one side of the machine, and then turning a small lever.

In addition to the advantages already mentioned, this instrument indicates clearly where added equipment or replacements will eliminate losses. It shows whether inspectors are visiting machines as often as they should, and whether machines are being cleaned and oiled often enough.

The Chronolog supplies the foreman with facts on which to base recommendations to the management. It shows him which operators are the best producers and eliminates differences of opinion on bonuses, premium rates, and piece-work rates by giving the foreman more complete data than he could get from time studies.

This instrument gives facts to the operator in support of his complaints and requests that the necessary attention be given to the machine. It gives him an immediate count of the number of pieces that he has produced, so that it is unnecessary for him to count the work in order to prevent over-runs or under-runs.

The Chronolog is distributed by the Graybar Electric Co. which maintains offices in the principal cities.

How Strong Organizations are Built

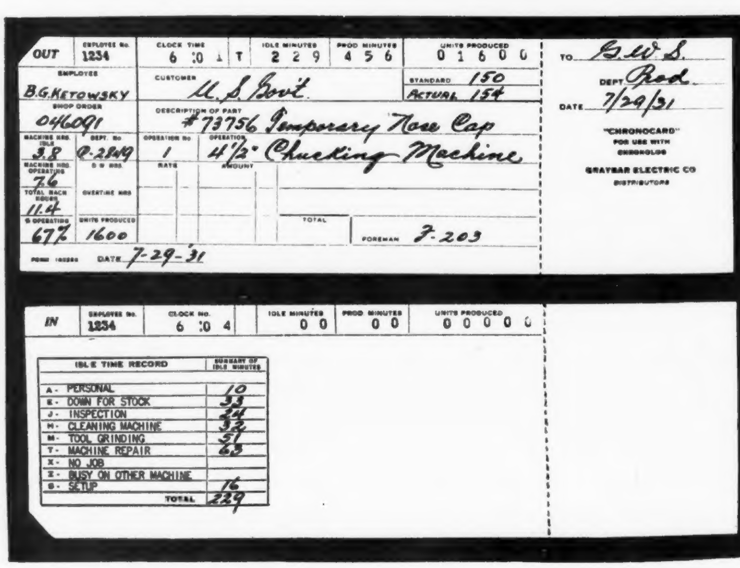
In a paper read before the management session of the American Society of Mechanical Engineers, James D. Mooney, vice-president of the General Motors Corporation, referred to the important part that continuity of employment plays in the building of a strong and efficient organization.

"Industrial administrators or organizers," said Mr. Mooney, "have still to recognize one very important element that is always to be found in any organization that has achieved stability, and this element is the presumption of continual relationship between the individual and the organization. An organization, to be strong and sound, must have its structure cemented with loyalty, and this loyalty can only be evolved out of implied continual and mutual interests.

"The classically strong organizations of state, church, and army have made good use of this element. In industry, union labor leaders have made excellent use of the presumption of continual relationship between the union man and the union, and accordingly they have often been able to challenge effectively the natural leadership of management. Union leaders at least presume to accept responsibility for the continual welfare of the man. The acceptance of responsibility, of course, generates authority, and authority endows leadership.

"Management in industry, on the other hand, makes very little pretense of a continual relationship between the industrial organization and the employe. Management hires and fires its wage earners on an hourly basis, and its salaried employes on a weekly or monthly basis. And these short units of time reflect the amount of presumption that exists in industrial organization generally, as to continuity of relationship."

Fig. 5. Front and Reverse Sides of the Chronocard which Supplies Desired Information to the Payroll, Production, Time Study, and Other Departments



OUT | EMPLOYEE No. 1234 | CLOCK TIME 6 :0 1 T | IDLE MINUTES 2 2 9 | PROD MINUTES 4 5 6 | UNITS PRODUCED 0 1 6 0 0
EMPLOYEE B.G. KETOWSKY | CUSTOMER U. S. Gov't. | STANDARD 150 | ACTUAL 154
SHOP ORDER 046091 | DESCRIPTION OF PART #73756 Temporary Nose Cap
MACHINE HRS. IDLE 3.8 | DEPT. No. C-2849 | OPERATION No. 1 | OPERATION 4½" Chucking Machine
MACHINE HRS. OPERATING 7.6 | D W HRS. | RATE | AMOUNT
TOTAL MACH HOURS 11.4 | OVERTIME HRS
% OPERATING 67% | UNITS PRODUCED 1600 | TOTAL | FOREMAN F-203
DATE 7-29-31

TO G. W. S.
DEPT Prod.
DATE 7/29/31
"CHRONOCARD" FOR USE WITH CHRONOLOG
GRAYBAR ELECTRIC CO DISTRIBUTORS

IN | EMPLOYEE No. 1234 | CLOCK No. 6 :0 4 | IDLE MINUTES 0 0 | PROD MINUTES 0 0 | UNITS PRODUCED 0 0 0 0 0

IDLE TIME RECORD	SUMMARY OF IDLE MINUTES
A - PERSONAL	10
E - DOWN FOR STOCK	33
J - INSPECTION	24
H - CLEANING MACHINE	32
M - TOOL GRINDING	51
T - MACHINE REPAIR	63
X - NO JOB	
Z - BUSY ON OTHER MACHINE	
S - SETUP	16
TOTAL	229

Automatic Welders Produce an Automobile Body Every Minute

Three welding machines, each of which is capable of producing from forty-five to sixty automobile bodies an hour, were recently built for a foreign manufacturer by the Federal Machine & Welder Co., Warren, Ohio. These machines are constructed to meet any normal angular requirement and to anticipate "Tear Drop" automobile bodies. The machines weigh 23 tons each and operate at a current cost of approximately 1 cent per weld.

In general construction, each machine consists of a heavy cast-iron frame on which two identical welding units are mounted in adjustable relation to each other. There are four heavy clamping arms which are raised and lowered hydraulically by a self-contained motor-driven unit. Flashing and upsetting are governed by generated cams that are motor driven through a variable speed control. All valves, hand switches, and the control mechanism, are located conveniently and are interlocked to prevent damage through careless operation.

The three machines are here shown on the erection floor of the plant in which they were built. They are covered by a U. S. patent.

Three High-speed Welding Machines which Produce from Forty-five to Sixty Automobile Bodies an Hour

* * *

Over 20 per cent of the trucks built in the United States since the first of the year have been shipped abroad; over 10 per cent of the passenger car output has been exported.

The Photo-Electric Relay Solves a Conveyor Problem

The Lamson & Sessions Co., of Cleveland, Ohio, had experienced difficulty in the transfer of tote pans loaded with bolts, weighing 70 to 150 pounds, to a gravity conveyor. These pans are lifted by two endless chains with conveyor carriers, and are then lowered and placed on the gravity conveyor. Each pan, when placed on the gravity conveyor, should slide and make room for the next pan. But often this did not happen. This meant that the second pan was deposited on top of the first one, and so on, until a pile of material accumulated.

The problem was solved by installing a light source on one side of the gravity conveyor and a General Electric photo-electric relay on the other. Now, if a pan fails to slide along on the gravity conveyor, it interrupts the beam of light. The photo-tube promptly actuates the relay, stopping the endless chain and allowing no more pans to come down until the blocking pan is shoved along.

In applications similar to the tote box control, the photo-electric relay could be arranged to actuate an electro-mechanical device, such as a Thrustor, which is a motor controlling a hydraulic cylinder, to push the box on its way automatically.

* * *

The index to the thirty-eighth volume of MACHINERY, September, 1931, to August, 1932, inclusive, is ready for distribution. Copies will be sent to readers upon request.

NEW TRADE LITERATURE

Recent Publications on Machine Shop Equipment, Unit Parts, and Materials. Copies Can be Obtained by Writing Directly to the Manufacturer.

MATERIAL-TESTING EQUIPMENT. Baldwin-Southwark Corporation, Philadelphia, Pa. Bulletin 40, on "The Scratch Extensometer," illustrating and describing a device small enough to be held in the hand and weighing less than an ounce, which may be applied for testing purposes in almost every field of industry where variations in stresses are to be indicated and measured. Bulletin 37, on "Huggenberger Tensometers," illustrating and describing a lever type of strain gage.

WELDING ELECTRODES. Metal & Thermit Corporation, 120 Broadway, New York City. Catalogue describing numerous applications of inorganic flux coated welding electrodes. The new booklet describes the welding of mild steel and boiler plate, stainless steel alloys, manganese steel, high-carbon steel, and stainless iron. The building up of railway rail ends, special manganese track work, and the repair of castings and heavy parts are also covered.

BEARINGS. Kingsbury Machine Works, Inc., 4324 Tackawanna St., Philadelphia, Pa. Bulletin S, containing data on Kingsbury thrust bearings and journal bearings for machinery with horizontal shafts, such as centrifugal pumps. The bulletin contains a list of dimensions and capacities of three types of mountings of combined thrust and journal bearings, and similar data on mountings for independent journal bearings.

PRECISION BORING MACHINES. Societe Genevoise d'Instruments de Physique, Geneva, Switzerland (R. Y. Ferner Co., 1127 Investment Bldg., Washington, D. C., American distributor). Catalogue 534-A, illustrating and describing the latest model of the Sip high-speed precision borer for laying out, locating, drilling, boring, and checking.

MOTORS. Master Electric Co., Dayton, Ohio. Catalogue Section 100, containing general information on the factory facilities behind Master motors. Circular entitled "Among Electrical Plants Worth Visiting—Master Electric Co., Dayton, Ohio," showing views in the various departments of this company.

METAL-CUTTING AND PIERCING MACHINE. S. A. Asquith & Son, 2514 Sunset Blvd., Los Angeles, Calif. Leaflet descriptive of the Asquith automatic metal-cutting and piercing machine for duplicating an infinite number of shapes from drawings or inexpensive templets.

POWER TRANSMISSION EQUIPMENT. Charles Bond Co., 617 Arch St., Philadelphia, Pa. Circular listing Bond stock gears and sprockets, as well as flexible couplings and truck casters. Circular GA-25, containing data on Bond speed-reduction units of light and medium series.

INDUSTRIAL SCALES. Kron Co., Bridgeport, Conn. Bulletin illustrating the completely redesigned line of Kron automatic industrial scales, including dial track, portable pan, portable platform, dormant platform, bench, hopper, crane, and pitless suspension types.

WORM-GEAR SPEED REDUCERS. Foote Bros. Gear & Machine Co., 215 N. Curtis St., Chicago, Ill. Revised catalogue 302 on "Hygrade" worm-gear speed reducers. The catalogue contains engineering information and technical data on this line of speed reducers.

FLEXIBLE COUPLINGS. D. O. James Mfg. Co., 1114 W. Monroe St., Chicago, Ill. Circular outlining the advantages of the D. O. James flexible coupling. Directions for ordering and for installing, as well as dimensions and list prices, are included.

MOTORIZED SPEED REDUCERS. Falk Corporation, Milwaukee, Wis. Bulletin 260, announcing the Falk "Motoreducer," a combination motor and speed reducer. The bulletin covers sizes, dimensions, specifications, method of selection, and other engineering data.

WELDING EQUIPMENT. Lincoln Electric Co., Cleveland, Ohio. Bulletin describing the important features of the new Lincoln "Shield-Arc" welder which is designed to meet the requirements for faster and more economical welding.

ELECTRIC HOISTS. Philadelphia Gear Works, Erie Ave. and G St., Philadelphia, Pa. Circular descriptive of the Philadelphia electric hoist, a new light-weight high-lift electric hoist of 1/4, 1/2, 1, 1 1/2, 2, and 3 tons capacity.

PRECISION BALL-BEARING CENTERS. Ready Tool Co., 550 Iranistan Ave., Bridgeport, Conn. Folder containing information on the Ready complete line of precision ball-bearing centers for lathes and cylindrical grinders.

STAINLESS WELDED TUBING. Carpenter Steel Co., Reading, Pa. Bulletin on Carpenter stainless welded tubing, containing general information, physical properties, and working instructions.

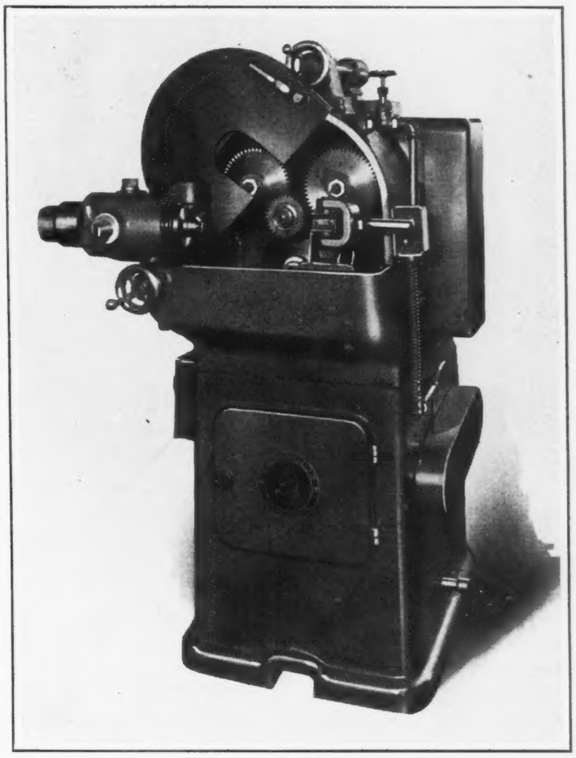
SILENT STEEL GEARS. John Waldron Corporation, New Brunswick, N. J. Bulletin 70, describing the features of the Waldron silent steel self-lubricating gears.

INDUSTRIAL TRUCKS. Clark Tructractor Co., Battle Creek, Mich. Vest-pocket catalogue illustrating various types and sizes of Clark trucks and Tructractors.

RUBBER. B. F. Goodrich Rubber Co., Akron, Ohio. Booklet containing information on hard rubber in sheet, rod, and tubing form.

Shop Equipment News

Machine Tools, Unit Mechanisms, Machine Parts and Material-Handling Appliances to Meet the New Needs of Industry



Fellows Gear-Lapping Machine

A "Three-lap Recess-type" lapping machine is being introduced on the market by the Fellows Gear Shaper Co., 78 River St., Springfield, Vt., in which the work is reciprocated between the laps at a fairly high rate of speed, and in addition is rotated in engagement with the laps. The reciprocating action causes an adequate distribution of the lapping compound over the gear and lap teeth. High production and accurate work are the advantages claimed for this construction. The spindle that carries the work is positively driven through change-gears, and the three laps are rotated by the work.

This machine has been developed for lapping external spur, helical, and herringbone gears after hardening so as to smooth the tooth profiles and remove any slight distortions resulting from the heat-treatment. The machine is automatic in operation, each gear being lapped for a definite period, so that consistent results are not dependent upon the skill of the operator.

Independent adjustable friction brakes, such as seen in Fig. 1, are applied to each of the three lap-spindles, so that the pressure of the laps on the work can be varied to suit conditions. Since the work affords the only positive drive to the laps, and since free rotation of the laps is restrained by friction brakes, the pressure of the laps is equally distributed and the lapping action thereby equalized. The drive for the reciprocating motion of the work-spindle and that for the rotary motion are independent of each other. Thus, the rotative speed and the number of strokes per minute can be changed to suit the number of teeth in the gear being lapped. The length of stroke can also be varied.

In order to change the pitch-line contact of the three laps on the work, each lap can be made with a different number of teeth. The center distances between the work-spindle and the lap-spindles are not adjustable, but through the medium of an independent mechanism, the two upper lap-spindles can be set at a slight angle relative to the axis of the work. This feature makes possible the correction of slight errors in the axial relationship of gear teeth resulting from distortions in heat-treatment. It is especially advantageous in lapping helical gears.

The amount of offset or misalignment of the two upper spindles is indicated by the dial indicators seen in Fig. 2, which read to 0.0001 inch. Hence, the operator has the means at hand, when he once knows the error in the lead of a gear, for accurately setting the machine to make the necessary correction. The two upper lap-spindles are mounted in self-aligning ball bearings.

Spur-gear laps are employed for lapping spur gears, and helical laps for helical and herringbone gears. The machine is particularly adapted for lapping shoulder gears and gears having a recess at the end of the teeth.

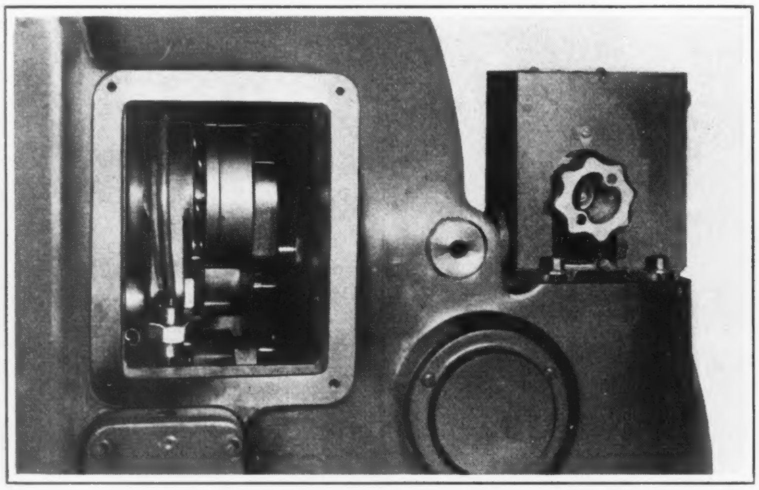


Fig. 1. Friction Brakes Restrain Free Rotation of the Laps, and an Electric Limit Switch Controls the Automatic Operation of the Machine

Laps made of a good grade of cast iron are customarily used in the machine, and the best results have been obtained with a lapping compound of from 320 to 400 grit. An oil should be used that will keep the compound in suspension.

The finish on the work and the time required for lapping are controlled by three factors: (1) The amount of lapping necessary to remove inaccuracies; (2) the lapping compound used; and (3) the rotating and reciprocating speeds employed. For the average gear it is best to employ a slow rotating speed, a high reciprocating speed, and a comparatively short stroke. With a 26-tooth gear of 3/4-inch face, for instance, the reciprocating stroke should not exceed 1/4 inch (this would, of course, be governed somewhat by the design of the gear), and should be at the rate of about 400 strokes per minute. The rotating speed should be about 200 surface feet per minute at the pitch line. The lapping time varies from one to four minutes.

This lapping machine is designed for individual motor drive. A two-horsepower motor, running at 1200 revolutions per minute, is located in the base. Power is delivered through a single pulley for operating both the work rotating and reciprocating mechanisms, as well as the lubricating pump and electric limit switch. A 1/2-horsepower motor, running at 1800 revolutions per minute, is also mounted in the base to drive the compound pump. This pump is equipped with an agitator which keeps the compound mixed. The pump can run at full capacity and, at the same time, the flow of compound to the work can be restricted to suit requirements.

National Acme Chaser Grinder

A machine designed specifically for grinding tap and die chasers has been developed by the National Acme Co., Cleveland, Ohio. Although the illustration shows a machine of the

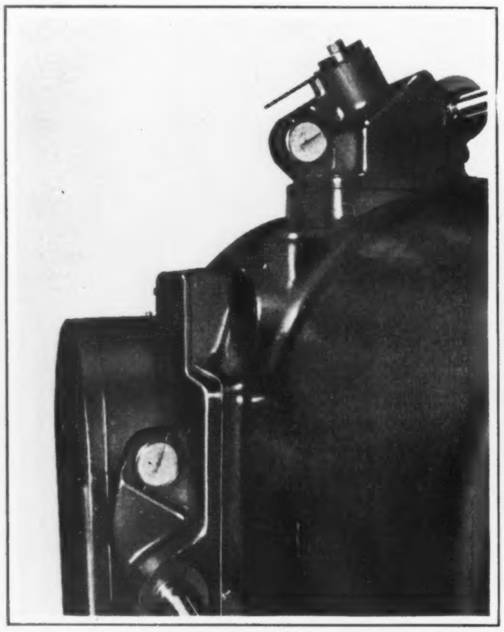
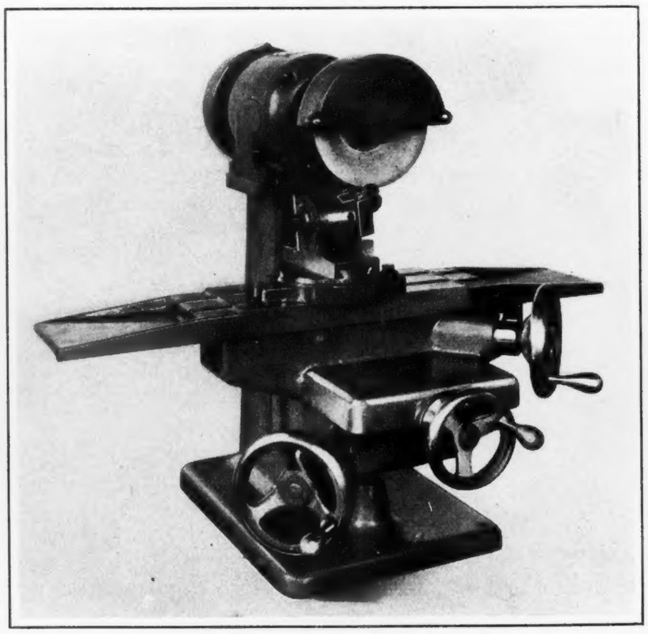


Fig. 2. Dial Indicators Insure Accurate Setting of Upper Lap-spindles



Tap- and Die-chaser Grinder Brought out by the National Acme Co.

bench type, a cast-iron base mounted on casters can be supplied to adapt the machine for portable use.

In large shops, this machine can be installed close to threading machines, so that the chasers need not be carried to a tool-room at some distant point for reconditioning. The machine operator himself can duplicate the desired angles of rake and clearance. In the tool-room, the machine can be used for a wide diversity of work.

The knee can be raised or lowered and the table moved toward or away from the column so that a wide range of work can be handled. The table has a travel of 13 inches, the cross-slide a movement of 5 1/2 inches, and the vertical slide a movement of 6 inches.

The motor is of a fully enclosed ball-bearing design, and has a rating of 1/2 horsepower. It can be driven from the nearest lighting circuit. The motor spindle is double-ended. A grinding wheel can be provided on both ends or a wire brush can be mounted on the rear end for removing feather edges and burrs from parts. The bench-type grinder, with the fixture, has a net weight of 246 pounds.

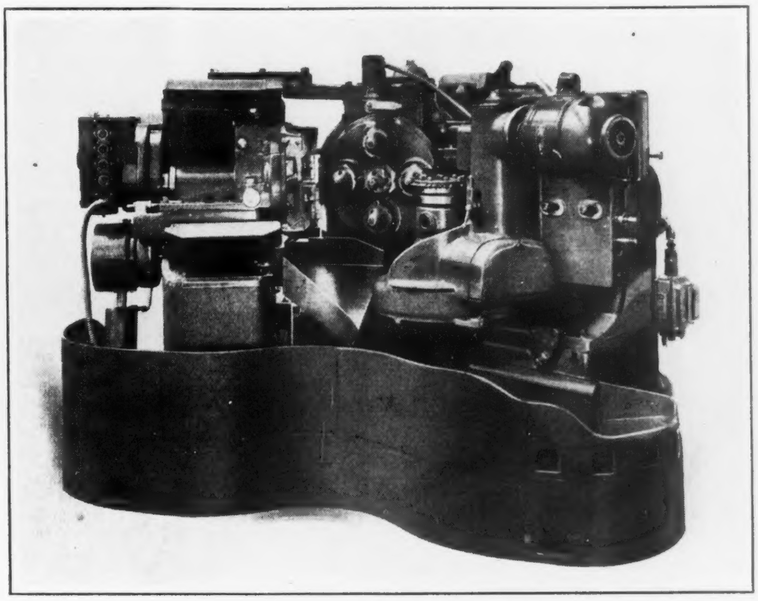


Fig. 1. Gleason Generator which Roughs and Finishes Differential Gears and Pinions in One Operating Cycle

Gleason Roughing and Finishing Differential-Gear Generator

Differential gears and pinions are both rough- and finish-cut in a No. 9 completing generator recently built by the Gleason Works, 1000 University Ave., Rochester, N. Y. The roughing of the teeth is accomplished by the inserted formed-blade circular cutter seen at the right in Fig. 2, while the finish-cutting is done by the two reciprocating tools at the left. By performing both cuts in one machine instead of in two as formerly, a number of important savings are effected, such as decreased labor costs, cutter and tool costs, floor space, and maintenance.

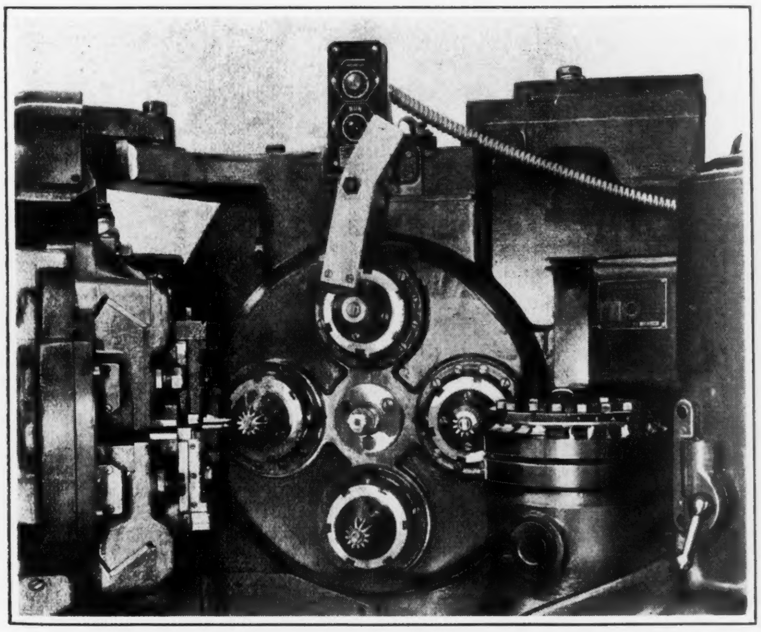


Fig. 2. The Four-station Work Turret, Circular Formed-blade Roughing Cutter, and Reciprocating Finishing Tools

The machine is loaded manually by placing a blank on each spindle as it is indexed to the uppermost station, the blank being automatically secured in place. The turret indexes the blank successively to the roughing station, to an intermediate station, and to the finishing station. After the finish-cutting, the turret advances the pinion to the loading station, where it is automatically released and removed by hand. Thus, after the machine has completed its first cycle, one finished gear or pinion is obtained with every 90-degree index of the turret drum. Provision is made to prevent a completed gear or pinion from proceeding through the cutting cycle a second time.

The roughing cutter has thirty-two blades and is approxi-

mately 10 1/2 inches in diameter. The shape of the blades depends upon the finished shape of the teeth to be cut. They are designed to remove the maximum amount of stock from the gear blank, so that an excessive amount of stock will not have to be removed by the finishing tools. It is an easy matter to change the cutter-blades. A gage is supplied for locating the roughing head in the correct position after the blades have been sharpened.

The feed of the roughing cutter into the blank is controlled by a cam. As each tooth is roughed out, the cutter is withdrawn, and the blank indexed to the next tooth until the blank has been completely roughed. The cutter-spindle is mounted vertically in anti-friction bearings and is equipped with a large balance wheel that insures a smooth cut. The cutting speed can be varied from 104 to 202 feet per minute through change-gears. This cutter unit is mounted on a cross-rail, secured to an upright.

The generating motion of the finishing unit is divided between the tools and the work, the relative roll being obtained through a crown gear and segment. A large double-gibbed cradle is oscillated in its housing by a cam to provide the generating roll. As the finishing tools reciprocate and roll through the generating motion, they remove the stock from the sides of the tooth and develop the correct profile. The tools are withdrawn from the work at the top of each roll after each tooth is finished, so as to permit indexing. The number of tool strokes can be varied from 350 to 550 per minute, the tools being mounted on slides which are reciprocated by a crank-plate. The tools operate on the draw-cut principle. Clearance between the tools and the tooth surface is provided on the return stroke.

The turret drum is indexed by means of a large ring gear attached to the drum, which is driven by a pinion through a slow start-and-stop mechanism. Notched plates and a dog locate the drum accurately in the operating positions. The spindle index mechanism is of the notched-plate type and is actuated by the generating roll. Each spindle is provided with an easily changed index-plate having the same number of notches as there are teeth in the pinion being cut.

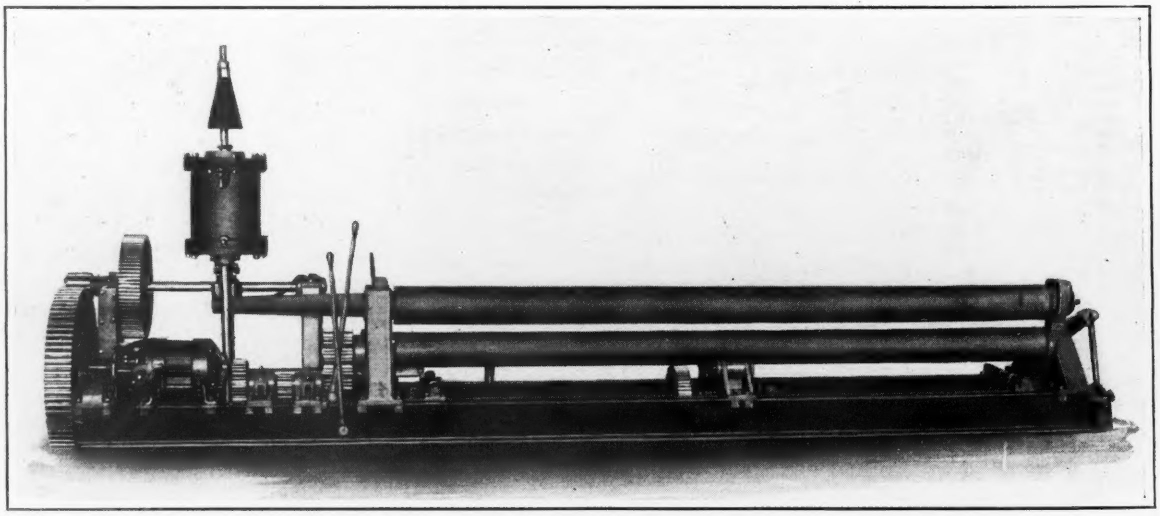
Four motors drive the machine, there being a two-horsepower motor for the roughing cutter, another two-horsepower motor for the finishing tools, a one-horsepower motor for the turret-indexing mechanism, and a five-horsepower motor for the feed mechanism of the roughing cutter, the generating mechanism, and the cutting-oil pump. One set of change-gears is required for each different feed and speed of the generating mechanism. The cutting time ranges from 3.9 to 11.3 seconds per tooth.

This machine occupies a floor space of 65 by 96 inches and weighs about 17,000 pounds.

Wickes Plate-Bending Roll with Pneumatic Features

A power knock-down and a power tip-up for the top roll, both of which are operated by air cylinders, are features of a heavy-duty, horizontal, pyramid-type plate-bending roll recently constructed by Wickes Bros., Saginaw, Mich. The air cylinder for the knock-down is located at the right-hand end of the machine, as seen in the illustration, while the air cylinder for the tip-up is on top of the machine near the left-hand end.

This machine has a capacity for mild steel plates up to 1/4 inch thick by 12 feet wide. It handles plates at the rate of 30 feet per minute. The top roll is 10 inches in diameter, but it is interchangeable with 7 3/4- and 8 3/4-inch rolls. The lower rolls are 6 inches in diameter. A 15-horsepower motor is used for



Wickes Plate-bending Roll with Air-operated Knock-down and Top-roll Tip-up

the main drive and a 5-horsepower motor for driving the elevating device. Power is transmitted to the elevating screws through bevel gears immersed in oil.

A one-shot system delivers lubricant to the various bearing points. The bearing for the tail-end journal of the top roll remains on the journal during a knock-down operation in order to prevent the entrance of scale or dirt. A dial indicator shows the position of the top roll.

Precision Bench Lathe Driven from Beneath

A bench lathe driven by a reversing motor located directly beneath the headstock as illustrated is the latest development of the South Bend Lathe Works, 426 E. Madison St., South Bend, Ind. Power is delivered from the motor to the headstock spindle through belts. A "down-pull" feature is obtained which is said to provide an unusually steady and noiseless drive.

This bench lathe is of the back-geared screw-cutting type and is available in 8-, 9-, and 11-inch swing. All standard screw threads, right or left hand, from 2 to 90 per inch, including 11 1/2 per inch pipe threads, can be cut. An index-plate shows at a glance the proper gearing to be used for any desired feed within the range provided. Six spindle speeds are available. A drum-type reversing switch, a graduated tailstock spindle, automatic feeds, and a precision lead-screw are provided.

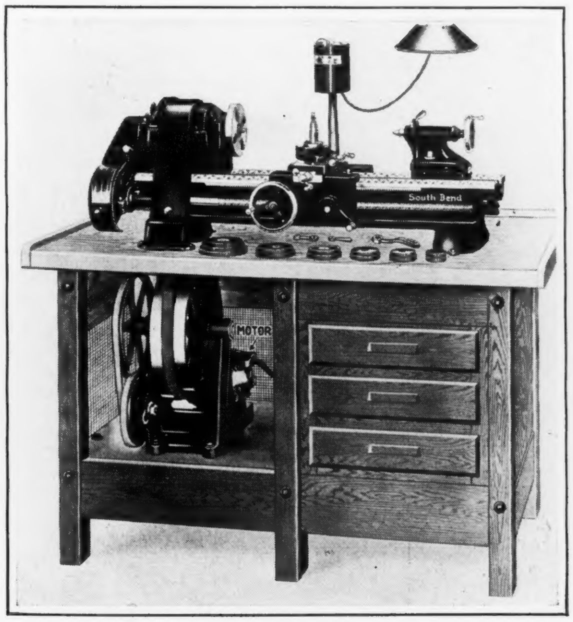
Cimatool Bench-Type Diamond Boring Machine

The City Machine & Tool Works, E. 3rd and June Sts., Dayton, Ohio, has recently developed a line of diamond boring machines of three types to meet a wide range of applications. The machine here illustrated is a bench type, adapted for boring such parts as bronze or babbitt bushings in the end frames of small electrical motors, the wrist-pin bearings of small refrigerator pistons, and many similar pieces. Holes up to 3/4 inch in diameter can be bored; another bench type machine is under development for holes up to 1 1/2 inches.

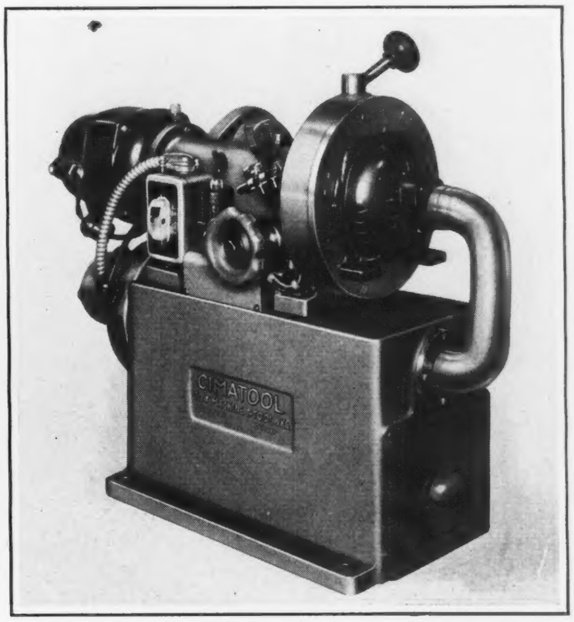
This machine is semi-automatic, as the operator places the work in position and starts the machine. The operating cycle is then fully automatic, the machine stopping after the bore has been completed. It is intended that the machine be used for high production, and so it is specially tooled for the job on which it is to be used. The illustration shows it equipped for boring a bronze bushing in a motor end frame. In this case the work is placed on a magnetic chuck. One of two electric switches is then pulled forward to energize the chuck and hold the work in place. The operator next pushes the tube of an exhaust system against the end of the work so that the borings will be carried away, after which he closes the second electric switch to start the machine.

The current for the motor is passed through the magnetic chuck in such a way that the starting switch is inoperative unless the chuck has been energized and is holding the work securely in place. With both switches closed, the spindle starts rotating and feeds the boring tool through the hole to be finished. The spindle is fed forward against the tension of a spring.

After the bore has been completed, an automatic trip opens the switches and thereby cuts off



South Bend Bench Lathe Driven by Reversing Motor Beneath the Headstock



Bench Type of Diamond Boring Machine Brought out by the City Machine & Tool Works

the current from the driving motor. Simultaneously, an electrically operated friction brake stops the rotation of the spindle. The clutch that controls the spindle feed is also released so that the spring can withdraw the spindle to the starting position. Because the spindle stops rotating before the return motion starts, there is no tendency for the tool to produce a spiral scratch in the finished bore.

Machines of this type could be equipped with a cooling system.

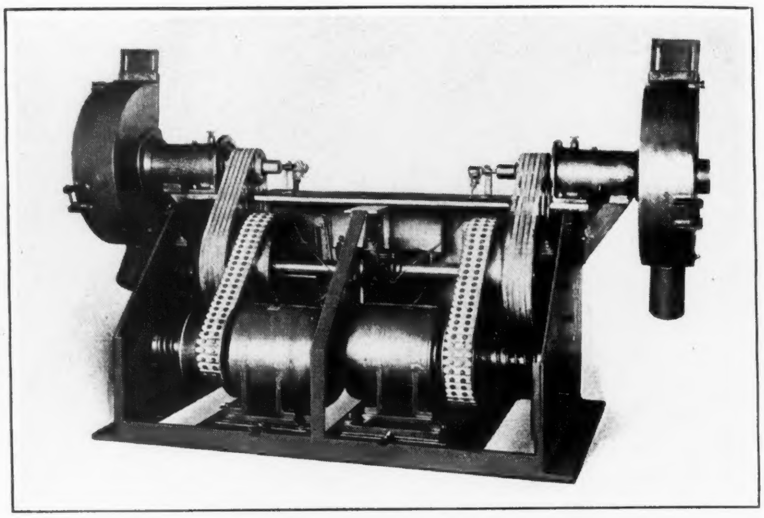


Fig. 2. Reeves Variable-speed Motor-pulley Units Give Spindle Speeds to Suit Wheels from 13 to 24 Inches in Diameter

Purair Helmet and Blower Unit

A helmet designed to give complete protection to workers against injurious dusts, fumes, vapors, etc., has been placed on the market by the W. W. Sly Mfg. Co., 4799 Train Ave., Cleveland, Ohio. Light weight is one of the advantages of this helmet. It is carried by a sweatband that extends around the head and by an air-deflector plate on top of the head. It is close-fitting over the shoulders, front and back, and a considerable portion of the weight rests on the shoulders. The helmet is adjustable for different operators. It consists principally of an aluminum frame and a rubber hood. The vision glass may be protected by a wire screen.

A Purair blower unit has also been designed to furnish dry filtered air to the helmet from outside the building. The helmet can also be attached to a compressed-air line by using a Sly filter and purifier.

Variable-Speed Floor Grinder

A two-spindle floor grinder with an infinite number of speeds between the maximum and the minimum has been placed on the market by the Production Equipment Co., 5219 Windsor Ave., Cleveland, Ohio. The infinite number of speeds is made possible by two Reeves variable-speed motor-pulley units. These units are quickly adjustable by means of handwheels located near the operator's station, as seen in Fig. 1. The drives to the two spindles are illustrated in Fig. 2.

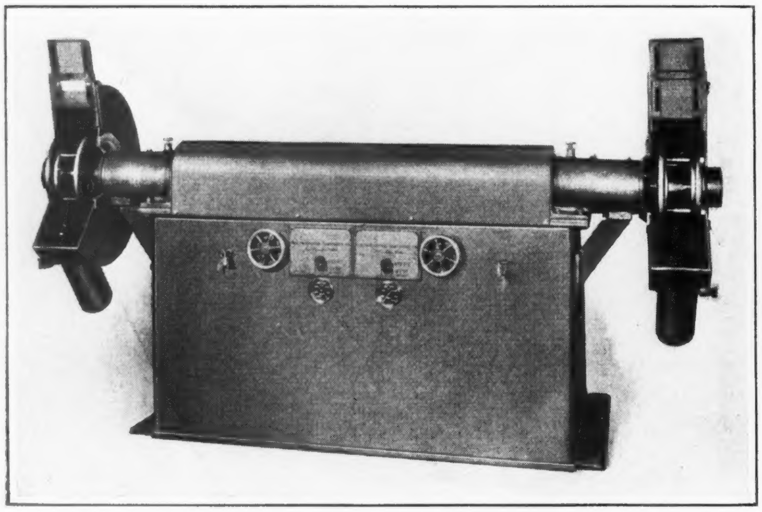
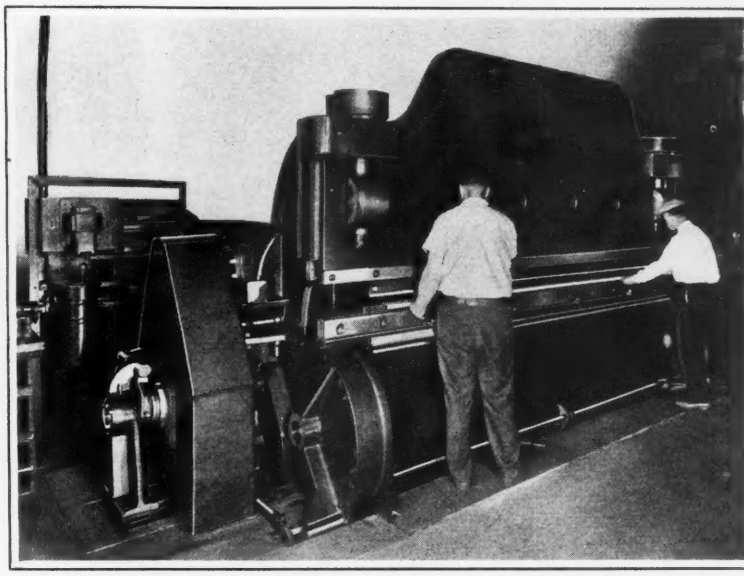


Fig. 1. Floor Grinder with Two Spindles that can be Run at an Infinite Number of Speeds between the Maximum and the Minimum

On each wheel guard there is a chart with five columns of figures that indicate the proper spindle speeds, in revolutions per minute, for obtaining peripheral speeds of 7500, 8000, 8500, 9000, and 9500 surface feet per minute with wheels from 13 to 24 inches in diameter. By positioning the lower end of the chart about 1/4 inch above the grinding wheel, the operator can quickly read the spindle speed necessary in order to obtain any predetermined peripheral speed.

Connected to one end of each spindle is a tachometer which the operator watches while he turns either handwheel until the tachometer indicates the desired number of revolutions per minute. After a spindle speed has been selected, the speed remains constant until it is again changed by turning the handwheel. Each variable-speed unit is equipped with a standard motor. Speed changes are effected by shifting the position of the motor in relation to the driven pulley. The grinder is of welded construction.

Rafter Welded-Steel Press Brake



Welded-steel Rafter Press Brake with Unusually Deep Ram and Bed

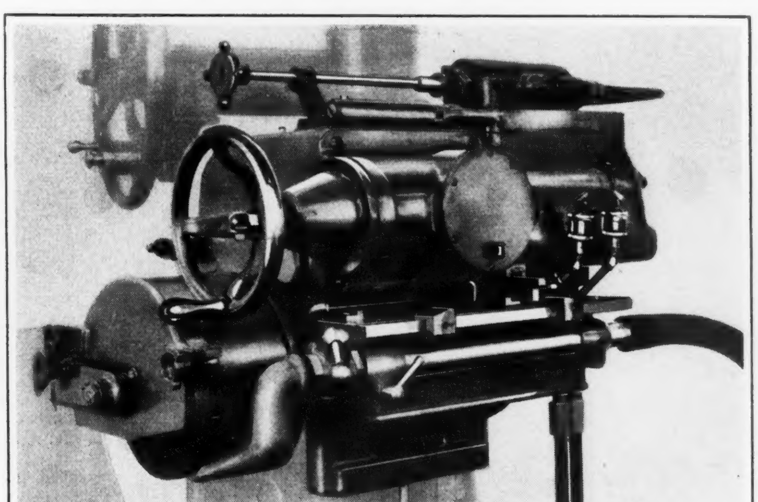
A Rafter press brake of welded steel construction, having an unusually deep ram and bed, was recently built by the Farrel-Birmingham Co., Inc., 377 Vulcan St., Buffalo, N. Y. This brake is designed on the same operating principle as the smaller machine described in January MACHINERY, page 379, the ram being pulled down from below instead of being pushed down from above. As will be noted from the illustration, all the driving mechanism is attached to, or contained within, the bed. Power is transmitted from the driving motor to a flywheel on the driving shaft through multiple V-belts and a friction clutch. Generated-tooth gears enclosed in oil-tight casings connect the drive and intermediate shafts with individual eccentrics at each end. These, in turn, actuate long C-shaped connecting-rods which operate the ram.

The base and ram are the only major members of this press brake. The construction is said to permit the concentration of weight and strength in the working parts. The machine is self-contained, being mounted on a heavy base made of rolled-steel plate welded into a girder section. This section is designed for minimum deflection under capacity loads. The gear casings and housings for the eccentric and gear-shaft bearings are welded to the bed. All welded parts are carefully annealed and normalized after welding and before machining.

The ram is a solid rolled-steel plate. It is unusually deep, not only through the center section, but also at the ends, thus allowing extra long gib ways without an increase in the over-all height of the machine. Rafter press brakes are built in a variety of sizes; the sizes most commonly used are carried in stock.

Automatic Cross-Feed for Norton Surface Grinding Machine

An automatic cross-feed or wheel-traversing mechanism that is hydraulically operated is now available for the 10- by 12-inch surface grinding machine built by the Norton Co., Worcester, Mass., which was described in April, 1931, MACHINERY, page 636. With this equipment, the wheel can be fed across the work at each reversal in any increment from 1/16 up to 1 1/2 inches. This permits the full width of the standard 1 1/2-inch wheel to be used. In the past, the greatest feed possible was only a fraction of the total wheel width.



Hydraulically Operated Cross-feed Developed for Norton 10- by 12-inch Surface Grinding Machine

The elimination of manual cross-feeding gives the operator time to gage the work or to run another machine. The direction of the wheel traverse is automatically reversed by the use of dogs which can be set to accommodate any width of work up to 10 inches.

Oil for the cross-feed is drawn from the same reservoir and by

the same pump that supplies the table-traverse mechanism. An adjustable metering device in the apron controls the amount of feed. From the metering device, the oil is delivered through a telescopic pipe to a traverse reverse valve on the vertical slide. The oil is conducted through ports from this valve to a cylinder on the under side of the vertical slide. A piston with double rods that equalize the displacement transmits the hydraulic power to the wheel-slide.

Truing of the grinding wheel is accomplished by operating the traverse valve manually, and the same control is used to disengage the power cross-feed so as to permit hand-feeding. The hand-feed wheel is automatically disconnected when the cross-feed is operated by power.

Reed-Prentice Drilling and Laying-Out Fixtures

A universal fixture for laying out work and for manufacturing drill jigs with holes up to 1/2 inch in diameter is being placed on the market by the Reed-Prentice Corporation, Worcester, Mass. This fixture, which is shown in Fig. 1, is made in two sizes with 12- and 20-inch-diameter rotary tables. The standard height under the cross-bar of the 12-inch size is 10 inches, and of the 20-inch size, 12 inches. Additional height can be secured by increasing the length of the posts.

The rotary table is graduated in minutes for accurate indexing. The cross-bar and the round longitudinal bar are so arranged that end measures can be used with micrometers for accurate spacing in either direction. The drill, which is used for either spotting or drilling, is mounted on an attachment that can be swung around to permit using the drill either in front or in back of the cross-bar.

The drill is accurately guided in a bushing which, on the 12-inch fixture, is suitable for drills up to 3/8 inch in diameter, and on the 20-inch fixture, for drills up to 5/8 inch in diameter. The fixture can be used on a vertical milling machine or on a drilling machine, in which case the electric drill is removed from its bracket. In addition to the spotting and drilling of work, the milling of templets to various outlines can be performed.

The same concern has also developed the universal ring-drilling fixture shown in Fig. 2. This fixture is designed for drilling holes around the periphery of adjusting collars and similar parts. Work from a minimum diameter of 1 1/4 inches up to a maximum diameter of 6 inches can be accommodated, while holes from 1/8 to 5/8 inch in diameter can be drilled.

Rubber Belting Designed for Endless Splicing on Machines

The B. F. Goodrich Co., Akron, Ohio, has brought out a new rubber belting designed primarily for use where power-transmission belting is to be spliced endless right on the machine. The new belt is known as "Highflex Junior." It is built up of an unusually large number of plies of a specially woven fabric. This belt is made only in widths of 6 inches and under, and is not to be confused with the "Highflex" belting brought out by the concern several years ago.

A special cement and tie gum for making the splice have also been developed by the Goodrich laboratories to insure belt joints of long life. Another necessary adjunct is an electrically heated, automatically controlled, portable electric vulcanizer made by the James C. Heintz Co., Cleveland, Ohio. A light templet for laying out and stepping down the ends of the belt to insure a good fit, and hand tools, complete the splicing equipment.

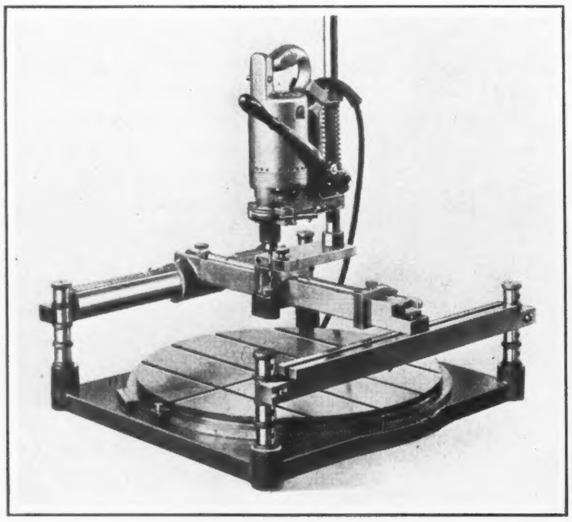


Fig. 1. Fixture that can be Used for Laying Out and Drilling Work or for Milling Templets

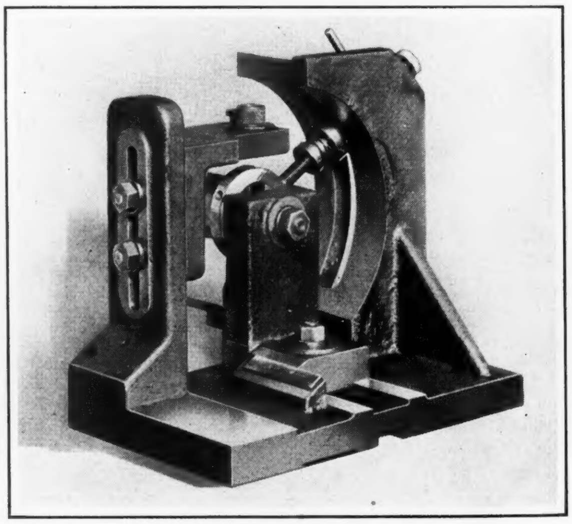
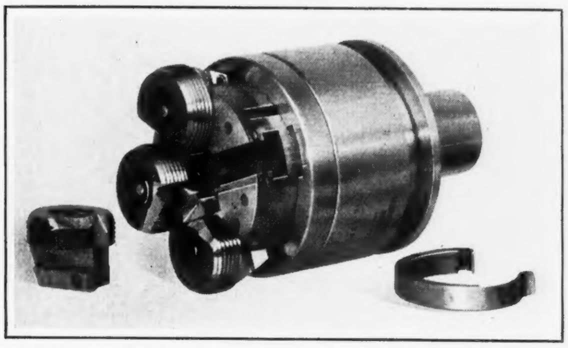
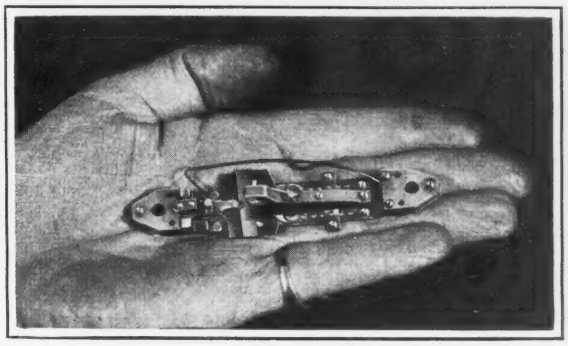


Fig. 2. Another Reed-Prentice Fixture Designed for Drilling Holes around Collars



Murchey Rotating Self-opening Die-head Equipped with Chasers Ground in the Thread



A Scratch Extensometer which Records Tension, Compression, and Shear Strains

Murchey Rotating Self-Opening Die-Head

A line of self-opening die-heads designed for use on any machine tool in which the die-head is revolved is being introduced on the market by the Murchey Machine & Tool Co., 951 Porter St., Detroit, Mich. This Type "RC" rotating die-head is made in sizes from 9/16 to 1 1/4 inches, inclusive. It is equipped with circular chasers that are ground in the thread. Long life and a cutting edge of permanent accuracy are two of the features claimed for these chasers. The die-head and chasers have been developed for long "production runs" where a high degree of accuracy is required.

The die-head is opened and closed automatically by means of a collar trip which insures a positive opening and accurate thread lengths. Thus the die-head is particularly suitable for use in multiple-spindle automatic screw machines and second-operation machines.

Each chaser is fitted to a splined locating post which passes through both the chaser and its holder. A worm-wheel is machined on the lower end of the locating post. Each holder is equipped with two worms which apply direct counter-forces to the cutting edge of the chaser through the worm-wheel. Adjustments to 0.001 inch are available through the worms. After the worms have been firmly set, the lock-nut on top of the chaser is tightened to insure rigidity of the unit. The cutting edge of each chaser is positively controlled by the two worms and the worm-wheel, and it is, therefore, possible to adjust the chaser to any desired cutting point.

The graduated adjustment is a valuable feature in regrinding chasers, since it eliminates the necessity of grinding off more than the worn portion. It is also possible to adjust the chasers (without regrinding) exactly to the desired cutting point. A single chaser can be reground or replaced without disturbing the remaining chasers.

The four chaser-holders can be removed by simply using the fingers, and the chasers are ground without taking them from their holders. After the chasers have been adjusted to the proper cutting points, the holders can be quickly replaced in their proper slots in the die-head body. Each chaser-holder is actuated by two springs located in the body directly in line with the point at which the load is imposed by the chaser. This construction insures an instantaneous trip of the holders without chance of their tipping or binding.

Scratch Extensometer

A small extensometer which records, by means of scratches, tension-compression strains and shear strains has been brought out by the Baldwin-Southwark Corporation, Philadelphia, Pa. This instrument weighs less than an ounce and is hardly larger than a teaspoon, as will be apparent from the illustration. It can be used on light or heavy structures. A special adaptation is required for recording shear strains alone.

The strain record is scratched on a target made of heat-treated steel, by a white diamond so mounted as to always be under a small adjustable load. The extensometer can be fastened to flat plates by means of vacuum cups when clamping is impracticable.

Cutler-Hammer Control for Press Drives

A simplified control for operating electro-magnetic clutches and brakes applied to power presses is being introduced on the market by Cutler-Hammer, Inc., 12th St. and St. Paul Ave., Milwaukee, Wis. The control incorporates patented features which are claimed to insure the safety of operators and give a flexibility that should help obtain maximum output.

The safety feature consists of several palm-operated push-buttons mounted directly on the slide of the press. In one method of operation, the operator must keep the buttons depressed with both hands in order to make the press slide descend to the bottom of the stroke.

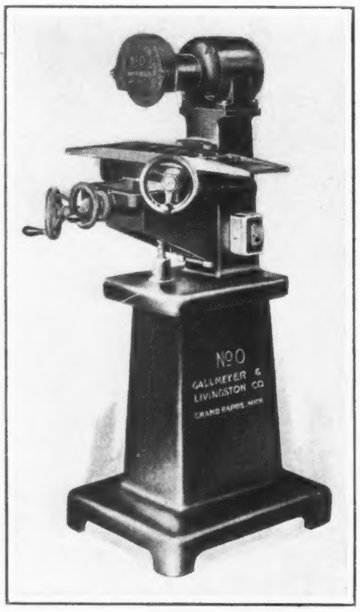
Flexibility of control is obtained by means of three additional methods of operation. For instance, when the "inching"

method is employed, the press will operate as long as the "inch" button is depressed, and will stop when the button is released, regardless of the slide position. It is claimed that this control permits of spotting work to an accuracy of 1/32 inch. When an automatic feed mechanism is employed, the control can be set to run the press continuously. The control can also be set to take the slide through one complete cycle by momentarily depressing the buttons.

Any one of the four methods of operation can be quickly selected. The transfer to any of the methods is made by means of snap switches. There is a stop-button for stopping the press instantly in case of emergency.

Grand Rapids Motor-Driven Surface Grinder

A No. 0 surface grinding machine with direct motor drive to the wheel-spindle has been added to the line of machinery built by the Gallmeyer & Livingston Co., Grand Rapids, Mich. This machine is intended for the accurate finishing of small work. The 6- by 1/2-inch grinding wheel is mounted directly on the shaft of the motor, the latter, in turn, being mounted on top of the column. The wheel-spindle runs in ball bearings. A 1/2-horsepower motor is standard equipment; it can be furnished for direct current or for 50- or 60-cycle alternating current, single phase or polyphase. The motor is controlled through a convenient switch.



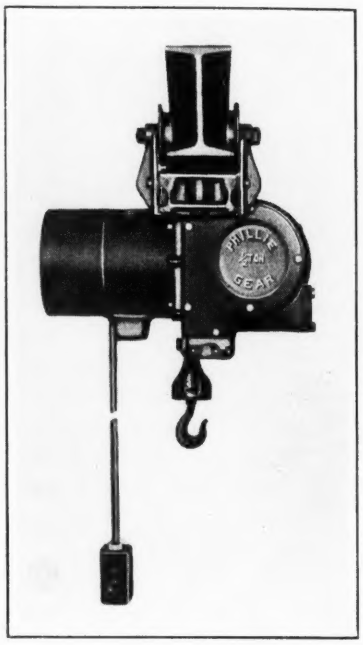
Small Surface Grinder with Wheel Mounted Directly on Motor Shaft

In addition to the column type grinder illustrated, this machine is available in a bench type. A portable column type can be supplied when it is desirable to move the machine from one department to another.

The knee is raised and lowered on the vertical ways of the column by means of the large handwheel which rotates the elevating screw. The table measures 5 by 29 inches over all, and has a working surface of 5 by 12 inches. Two T-slots are provided in the top of the table, and there is provision for attaching a magnetic chuck. A longitudinal table travel of 12 inches is obtained through a rack and spiral pinion actuated by one of the handwheels. The spiral pinion insures a smooth table action. A cross-feed of 5 1/2 inches is obtained by means of a third handwheel which is equipped with a dial graduated to 0.001 inch. The saddle fits dovetailed ways and bearings that extend the full length of the knee.

Cutler-Hammer Limit Stop for Cranes

A small-sized safety stop designed to prevent over-travel of the hoist on electric cranes is made by Cutler-Hammer, Inc., 12th St. and St. Paul Ave., Milwaukee, Wis., with standard mill-type blow-outs and contact tips. This stop can be used in installations using up to 40 horsepower. It is unusually small, taking only 9 inches of head-room. The stop is supplied with leads having soldering lugs. The cover is removable for inspection and repairs.



Phillie Gear Electric Hoist Made in Sizes from 1/4 to 3 Tons

"Phillie Gear" Electric Hoists

An electric hoist which is built in sizes from 1/4 to 3 tons capacity, inclusive, by the Philadelphia Gear Works, Erie Ave. and G St., Philadelphia, Pa., is shown in the accompanying illustration. These hoists have a high lift with a low head-room, and are designed for noiseless operation. No load brake is necessary. The hoists are so balanced that the load is always directly under the center of the rail. The swivel trolleys turn on a 4-foot radius.

Other features include an operating mechanism that is sealed against oil leakage and the entrance of dirt; interchangeable parts; standard motors; and Timken roller bearings for the various shafts. The hoists are controlled by push-buttons.

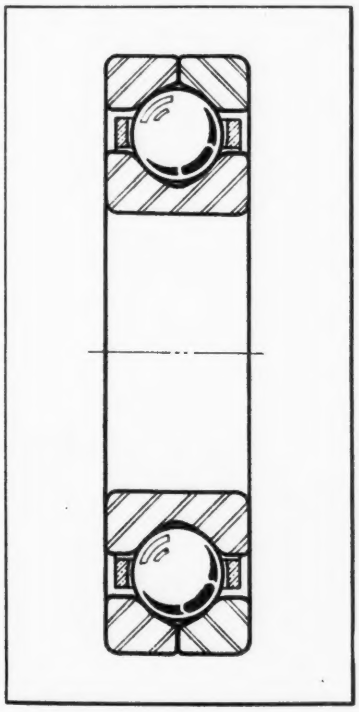
The hook swivels are equipped with ball bearings and so are the trolley wheels. The cable drums are of large diameter and have machined grooves. Nickled-bronze worm-wheels, hardened-steel trolley wheels, nickel-steel heat-treated helical gears, and hardened and ground-thread worms are other features of the construction.

Norma-Hoffmann Ball Bearings with Double Angular Contact

The latest addition to the line of "Precision" bearings made by the Norma-Hoffmann Bearings Corporation, Stamford, Conn., is a Type CD Duplex double angular-contact ball bearing. This bearing takes not only radial loads but also heavy thrust loads in either direction. It has a width no greater than that of a standard single-row ball bearing.

The outer ring is made in two parts as illustrated. Both the inner and outer raceways are ground to a special curvature for safely carrying heavy end thrust. A one-piece ball retainer of extruded bronze is carried on the ground flanges of the inner ring.

These duplex bearings are available in light, medium, and heavy metric series, with a bore from 10 to 100 millimeters. They should be used only where the thrust load exceeds the radial load. The double outer ring should be clamped tightly in the housing.



Norma-Hoffmann Bearing for Radial Loads and High Thrust Loads in Either Direction

General Electric Small Alternating-Current Hoist Motors

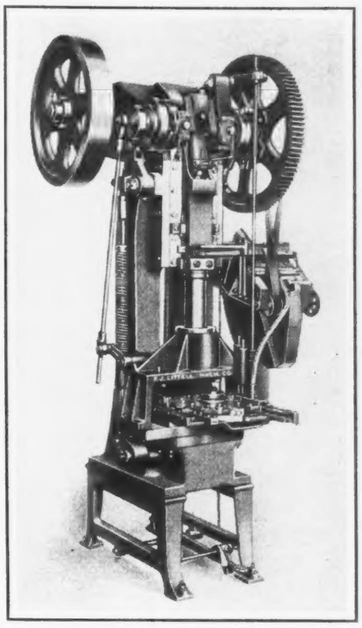
Alternating-current motors designed particularly for application to cranes and hoists of the smaller sizes are being placed on the market by the General Electric Co., Schenectady, N. Y., in sizes from 1 1/2 to 15 horsepower. These motors have high-resistance rotors, so that the maximum torque occurs at about a 10 per cent speed. In this way, a high torque with low starting current and a high power factor at starting are obtained. The high rotor resistance also gives a high slip at full load and a wide speed regulation with change of load, permitting the motor to slow down when hoisting heavy loads and thus modifying the power drawn from the line.

These Type KR motors are totally enclosed and can, therefore, be used in installations where considerable dust and dirt are present. The stators are of riveted construction, while the end frames are die-formed from heavy steel plate. As the stator punchings are of a high-grade silicon steel, they have uniform magnetic characteristics.

Littell Automatic Bushing Sizing Machine

An automatic bushing sizing machine recently built by the F. J. Littell Machine Co., 4127 Ravenswood Ave., Chicago, Ill., gives a production of approximately 18,000 pieces in a nine-hour day. The operation consists of marking the customer's trade name on the outside of the bushing at one station of the revolving dial and sizing the bushing at another station. The work is then carried to an ejection station, where the bushing is automatically pushed out of the dial and into a box.

Automatic operation is obtained by means of the blade-hopper feed on the right-hand side of the machine. This hopper picks up and aligns the bushings in a tube. Transfer slides load one bushing in each station of the dial.



Littell Bushing Sizing Machine with Automatic Feed

The press is equipped with a safety latch that will stop the ram stroke half way down in case the dial does not fully index, thus protecting the tools from damage. Also, the drive rod of the feed mechanism is provided with a pin that shears in case the feed jams, and in this way prevents the breaking of machine parts.

One operator can attend to several machines of this type, as his work consists only of refilling the hopper occasionally. By making minor changes, the machine can be used for various sizes of bushings.

Portable Gasoline-Driven Arc Welder

A P & H Hansen arc welder driven by a gasoline engine is being placed on the market by the Harnischfeger Corporation, 4404 W. National Ave., Milwaukee, Wis., in 100-, 200-, 300-, 400-, and 600-ampere sizes. All sizes are equipped with Waukesha engines that run at 1750 revolutions per minute. A flexible coupling joins the arc-weld-

ing generator to the engine. These welding units are mounted on arc-welded steel bases. The 100-ampere unit can be mounted on two wheels, the larger sizes being provided in four-wheel units.

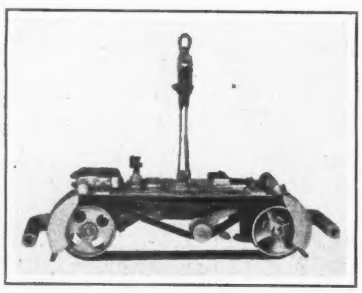
Hercules Belt Sander with Single Motor Drive

The Buckeye Portable Tool Co., Dayton, Ohio, has brought out a Hercules belt sander equipped with a single high-frequency electric motor. This motor was developed because it was found difficult to synchronize two electric motors.

This belt sander (see illustration) is adapted to smoothing down welds, sanding automobile bodies, smoothing large steel dies, and finishing metal, wood, or stone surfaces. It is operated by one man, being suspended over the job by a cable.

A feature of the sander is a system of cooling by compressed air. Dust or grit are prevented from getting into the motor by this system. Compressed air is also used to obtain automatic belt tension. Through the use of a belt idler, it is possible to use manufactured abrasive belts over an endless leather belt. However, canvas-coated belts are used with the addition of guide rolls. The pulleys run at a speed of 4500 revolutions per minute.

The high-frequency motor has also been applied to a new Hercules cup-wheel grinder. This grinder is used on weld seams and for surfacing large castings, as well as for grinding dies and flat metal.

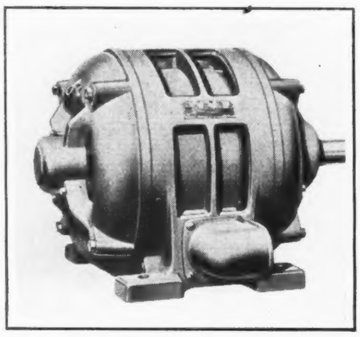


Belt Sander with High-frequency Motor and Compressed-air Cooling System

Louis Allis Rapid-Reversing Motors

Squirrel-cage motors capable of making as many as sixty reversals per minute continuously without overheating have been developed by the Louis Allis Co., Milwaukee, Wis. The high rates of reversal have been made practical through a light-weight rotor construction, adequate ventilation, high torque characteristics and shock-resisting cast-iron frames.

Reversing motors are now made by this concern for practically all machines that employ fast reciprocating or reversing motions or require frequent starting and stopping. In the machine tool field, these motors are particularly applicable to tapping, threading, broaching, slotting, and milling machines, as well as planers. On such machines, they eliminate shifter clutches, tripping mechanisms, gears, belts, etc.

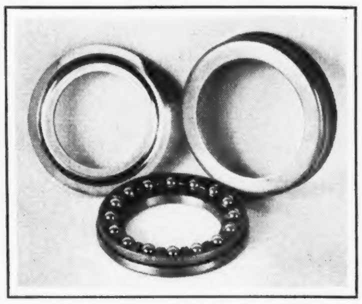


Squirrel-cage Motor which can be Reversed Sixty Times per Minute

These rapid-reversing motors can be furnished in the standard open ball-bearing type illustrated or in a rolled-shell shaftless type, as well as in vertical, single-speed, multi-speed, enclosed fan-cooled, and other squirrel-cage styles.

Bantam Ball-Thrust Bearing with Lubricant Retainer

A ball-thrust bearing with a cast-bronze retainer for the balls, instead of the conventional pressed-steel retainer, has recently been designed by the Bantam Ball Bearing Co., South Bend, Ind. This bearing was brought out primarily for application to the clutch-release mechanism of automobiles. A special grease-retaining band is provided around the outside of the bearing. This band extends down on one side past the center line of the balls so that the grease is held within the bearing.

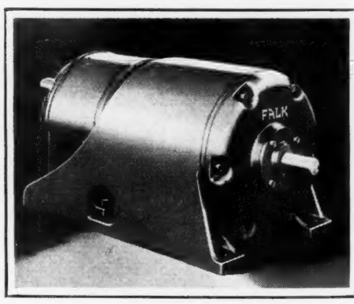


Bantam Ball Thrust Bearing with Cast Ball Retainer and Lubricant-retaining Band

With the bronze retainer and grease-retaining band, it is possible to eliminate the oil-tubes and grease fittings commonly used, because the bearing seldom needs to receive lubricant after it has been installed on an automobile.

Falk Single-Unit Motorized Speed Reducers

Three styles of combined motors and speed reducers known as "MotoReducers" are being introduced to the trade by the Falk Corporation, Milwaukee, Wis. In the integral type, the motor end-



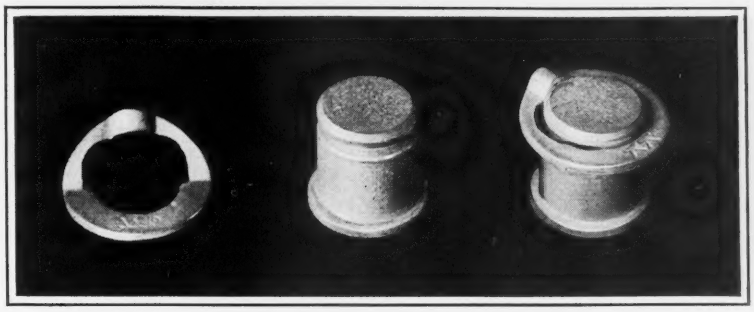
Falk Combined Motor and Speed Reducer of the All-motor Type

bell is removed and the motor is close-coupled to the gear-case through a bayonet type of joint. In the flexible type, a round-frame motor is used and the end-bell is retained. In the third or all-motor type, the motor is connected to the reducer housing by means of a Falk flexible coupling. Any standard horizontal motor can be used with this type.

All three of these types are available in horsepower ratings from 3/4 to 75, with ratios from 4.6 to 288. Non-planetary helical-type gears are used throughout. Ball bearings are employed in all but the larger sizes. In each model the gear housing acts as a support for the motor, and thus insures rigidity. Compactness and simplicity are other advantages claimed for this design.

Philadelphia Combined Motor and Speed Reducer

The Philadelphia Gear Works, Erie Ave. and G St., Philadelphia, Pa., have brought out a horizontal motor and speed reducer combination of the design here illustrated. The motor and gear apparatus of this "Motoreducer" are contained in one housing with supporting feet at each end of the frame, so that neither the gearing nor the motor is overhung. Conservation of space and the elimination of vibration and noise are other advantages claimed for this construction. All working parts are easily accessible.



How the "Kwik Klip" Washer is Applied

The gears are made of heat-treated nickel steel and have helical cut teeth. They run in an oil bath. All bearings are of the anti-friction type. The slow-speed shaft is mounted in Timken roller bearings, widely spaced, which permits a pinion, sprocket or pulley to overhang without the necessity of using an outboard bearing support.

This motorized speed reducer is available in single, double, and triple types, with ratios up to 450 to 1. It can be furnished with standard open-type or totally enclosed fan-cooled motors, either polyphase or single phase. The unit is also available with direct-current motors up to 10 horsepower.

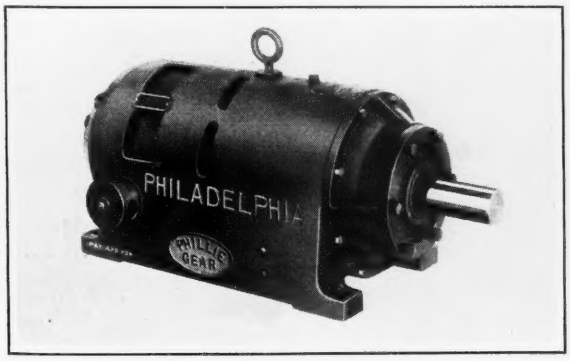
"Kwik Klip" Lock-Washer

A retaining washer known as the "Kwik Klip" is manufactured and licensed to be manufactured by Robert F. Krejci, 3551 Randolph Road, Cleveland Heights, Ohio. This washer, which is of the design seen at the extreme left in the illustration, has an opening of unusual outline and is bent up on one side to an angle of about 45 degrees. The pin or bolt to which the washer is to be applied is grooved to suit the thickness of the washer.

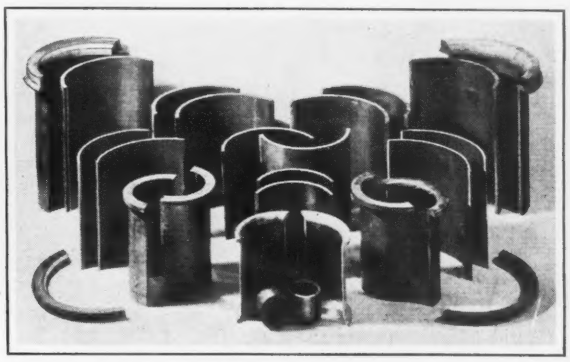
In applying the washer, the edge of the hole in the flat portion is merely slipped into the groove in the pin and then the bent side of the washer is pressed down straight with the flat side. This locks the washer securely in place and gives 180 degrees of thrust bearing between the washer and the pin.

Ryerson Synthetic-Resin Bearings

Bearings made from synthetic resin, with textile material as the base are being introduced on the market by Joseph T. Ryerson & Son, Inc., 16th and Rockwell Sts., Chicago, Ill. These Ryertex bearings are made by methods similar to those generally fol-



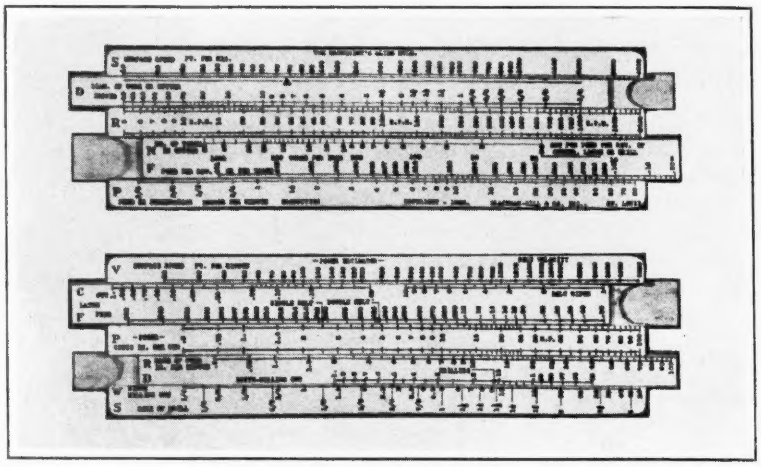
"Motoreducer"—a Recent Product of the Philadelphia Gear Works



Various Styles of Ryertex Synthetic-Resin Bearings

lowed in the production of synthetic plastic products. They show a Brinell reading of from 30 to 40, and a scleroscope reading of from 70 to 80. Long wear is an advantage claimed for the bearings, and service tests have shown them to be particularly satisfactory in cases where it is easier to use water as a lubricant than oil.

Machinists' Slide-Rule



Front and Reverse Sides of a Slide-rule Intended for the Machinist

A calculator designed especially to aid the shop man in solving his everyday problems has been developed by Blackman-Hill & Co., 1513 N. Broadway, St. Louis, Mo. The illustration shows the front and reverse sides of this "Machinists' Slide-rule." With this calculator can be found the proper speed for work or cutters; the proper feed per tooth, revolution, or minute in milling, drilling, turning, and boring operations; and power required for a given speed, feed, and depth of cut, based on cubic inches of metal removed per minute.

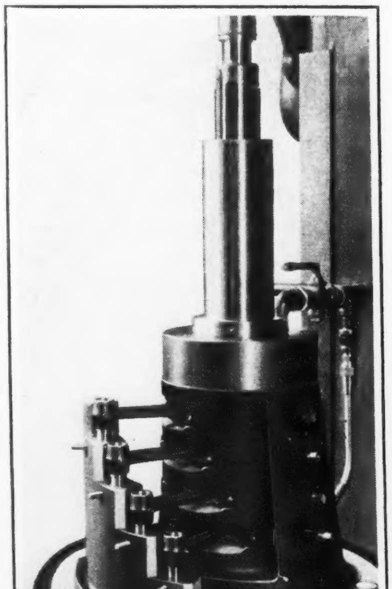
This calculator measures 7 inches by 2 inches by 1/4 inch, and consists of ten graduated scales mounted on a box-wood rule having four dovetailed slides.

Honing Shallow Open-End Holes

Up to the present time, honing has been confined mainly to the finishing of cylinder bores, tubes, etc., the length of which exceeded the diameter. In other words, honing has not been adapted to the accurate finishing of holes in rings or other parts of narrow width. This field includes a large variety of ferrous parts that are produced in sufficiently large quantities to warrant the use of high-production equipment.

Recently, the Micromatic Hone Corporation, Detroit, Mich., developed a tool and fixture for honing the crank-pin hole in connecting-rods of a new V-type eight-cylinder engine. The crank-pin hole in these rods is later fitted with a floating bearing, the internal surface of which turns on the crankshaft and the external surface in the connecting-rod. The bore in the connecting-rod must be finished within a tolerance of 0.0003 inch. The honing tool is of a three-finger, fully automatic design.

The principal differences between this and other honing operations are that the work floats and the tool is piloted, and that a number of pieces are honed simultaneously. Each connecting-rod floats independently of the others, so that there is no cumulative error resulting from previous machining operations. The pieces are centered and held in alignment by resilient wiper guides mounted in the body of the honing tool. This obviates the necessity for clamping or locking the connecting-rods. The guides extend beyond the abrasive members of the honing tool, as seen in the illustration, so as to keep two or more connecting-rods in alignment all the time. The honing stones float relative to the tool body and the work, so as to compensate for uneven stone wear and prevent the abrasive sticks from disturbing the alignment of the connecting-rods.



Honing the Crank-pin Hole in Four Connecting-rods

Time studies made under average production conditions show that from 0.0007 to 0.0012 inch of stock can be removed from a ground hole in an actual honing period of 25 seconds, the floor-to-floor time being 40 seconds. From 0.001 to 0.0015 inch of stock can be removed from a diamond-bored hole in 45 seconds actual operating time (floor-to-floor time, one minute). This operation is performed on a hydraulically operated machine built by the Barnes Drill Co.

MEN IN THE INDUSTRY

Frank J. Oliver, Jr., formerly western editor of the *American Machinist* and *Product Engineering*, has been appointed coordinator of the College of Engineering, University of Detroit. The college is one of the cooperative engineering schools that place emphasis on practical work in industry. The students spend four weeks in school alternately with four weeks in accepted industrial firms. Mr. Oliver's work will include the placement of students in the Detroit industrial area, which offers splendid opportunities for coordination in all phases of engineering.

Harold V. Coes, manager of the industrial department of Ford, Bacon & Davis, Inc., New York City, James D. Cunningham, president of the Republic Flow Meters Co., Chicago, Ill., and C. F. Hirshfeld, chief of the research department, Detroit Edison Co., Detroit, Mich., have been elected vice-presidents of the American Society of Mechanical Engineers to serve for two years.

Louis E. Underwood, managing engineer of the stationary motor engineering department of the General Electric Co. at Lynn, Mass., has been appointed manager of the Pittsfield, Mass., Works of the company to succeed E. A. Wagner, who has retired.

Julius F. Stone, Sr., has been elected president of the Case Crane & Kilbourne Jacobs Co., Columbus, Ohio, manufacturer of warehouse trucks, traveling cranes, wheelbarrows, wheel scrapers, structural steel, etc.

Walter C. Keys, consulting engineer, Detroit, Mich., has been elected a member of the Council of the Society of Automotive Engineers, Inc., 29 W. 39th St., New York City, to fill the unexpired term of the late Fred S. Duesenberg.

G. E. Tenney has been appointed sales manager for the Chicago district of the Lincoln Electric Co., Cleveland, Ohio. The Chicago office is at 1455 W. 37th St.

Aiding Industry in Applying Standardized Tolerances

The Committee of the American Society of Mechanical Engineers on Allowances and Tolerances for Cylindrical Parts and Limit Gages (R. E. W. Harrison of Cincinnati, Ohio, chairman) aims to bring into line with present-day shop practice the system of fits and tolerances tentatively approved by the American Engineering Standards Committee (now the American Standards Association) in December, 1925.

The standards have not been adopted very generally by industry, and some differences of opinion have developed in the engineering profession, calling for a review of the standards and, probably, a partial revision.

The members of the Committee recognize the magnitude and importance of the task with which they are confronted, but believe that, with the active cooperation of the machinery industries, a standardized system can be evolved that will be generally acceptable.

In a statement issued by the Committee, the following points are brought out: Experience has taught the necessity for recommending a system that can be reasonably well adhered to, both economically and mechanically. Hence, all recommendations should be characterized by simplicity in their presentation. Proposed recommendations will be put into operation by practical men and should, therefore, be of such a character as to be readily endorsed by them, as well as by the manufacturers of tools and gages, and by tool supervisors, designers, production engineers, and inspectors. While theoretical considerations cannot be ignored, they should not become part of the recommendations if they interfere with the practicability of the standards proposed.

In the past, standards have been recommended based on the assumption that it is possible to buy reamers, drills, and other equipment that will produce work of absolute accuracy. Since this is not practicable, standards for tolerances must be made in the light of the knowledge that such tolerances are inseparable from the tools and equipment used to produce the work. The Committee hopes that as its work progresses, it will have the wholehearted support of industry in the work undertaken.

There is no doubt that this support will be forthcoming if the Committee is able to meet the needs of industry by closely following the excellent guiding principles laid down in its organization plan.

New Manager of Machine Tool Association

Herman H. Lind has been appointed general manager of the National Machine Tool Builders' Association, according to an announcement made by the Association's directors. Mr. Lind was born in Canton, Ohio. He was first employed with the Columbus Buggy Co., Columbus, Ohio, and later went with the Ohio Body & Blower Co. of Cleveland, where he remained for seventeen years, advancing to the position of vice-president. In 1922, he opened his own office as business consultant, and two years ago he became general manager of the Malleable Iron Institute. His experience has given him a broad training as an executive directing accounting, sales, engineering, and manufacturing.

Crating Machinery for Shipment

In an article in November Machinery on "How to Crate Machinery to Prevent Damage in Transit," John G. Davies, whose article in the September number gave some worthwhile advice to machinery builders, will describe in greater detail some of the things to do and some of the things not to do in crating machinery. Mr. Davies holds that a correct knowledge of the proper method of packing and crating is just as important as an understanding of the basic principles of construction of the machine. Such questions as the importance of proper bracing, how to avoid direct pull on nails, and how to prevent the shifting of the load are among the subjects dealt with. Those responsible for the shipping of machinery will find this article of great value.

New Publications

Foremen's Safety Conferences. 23 pages, 7 3/4 by 10 3/4 inches. Published by the Policyholders Service Bureau of the Metropolitan Life Insurance Co., 1 Madison Ave., New York City. Distributed without charge.

This pamphlet contains suggested programs for a series of seven foremen's conferences to discuss various phases of accident-prevention work. The material presented covers the fundamental principles of safety work as applied to all types of industry.

NEWS OF THE INDUSTRY

ABEL DAVIS and FRANKLIN H. FOWLER, Receivers in Equity for the FOOTE BROS. GEAR & MACHINE Co., 215 N. Curtis St., Chicago, Ill., announce that arrangements are being made, with the approval of the Federal Court, to move all manufacturing operations of the company now being carried on at the Curtis St. Plant to the Plamondon Division at 5301 South Western Ave., Chicago. This consolidation of manufacturing operations of the gear and reducer division in one plant will effect great savings in production costs and operating expenses, and will speed up deliveries.

GEORGE D. MILLER, district manager of William K. Stamets, Cleveland, Ohio, for the last twelve years, has opened an office at 2168 W. 100th St., Cleveland, where he will handle several lines of high-grade machine tools. Mr. Miller has been appointed exclusive representative of the Heller Machine Co., manufacturer of cold-metal sawing machines, saw-sharpening machines, centering machines, and circular saws in the northern Ohio territory.

MURCHEY MACHINE & TOOL Co., 951 Porter St., Detroit, Mich., manufacturer of threading tools and machines, announces that the C. D. Proctor Co., 30 Church St., New York City, has been appointed representative of the company to cover the metropolitan district of New York as well as the New England states. H. F. Miller continues in charge of the New England office, at Slater Bldg., Worcester, Mass.

SIMMONS MACHINE TOOL CORPORATION, Albany, N. Y., engaged in the reconditioning and sale of used machine tools, has opened a display room and warehouse in Jersey City near the entrance to the Holland Tunnel. Stocks of rebuilt machine tools reconditioned in the Albany plant are maintained in the new warehouse.

INGERSOLL STEEL & DISC Co., Chicago, Ill., a division of the BORG-WARNER CORPORATION, has granted a license to the Allegheny Steel Co. of Breckenridge, Pa., to manufacture two-ply stainless steel sheets exclusively under the patents of the Ingersoll Steel & Disc Co.

CHAMPION RIVET Co., Cleveland, Ohio, announces that after forty years in the business of making rivets, the company has added a new line of general-purpose welding rods.

COPPUS ENGINEERING CORPORATION, Worcester, Mass., manufacturer of blowers and steam turbines, has appointed John B. Foley, Jr., 510 Hills Bldg., Syracuse, N. Y., representative.

CINCINNATI MILLING MACHINE Co., and CINCINNATI GRINDERS, INC., Cincinnati, Ohio, announce that the Chicago office of the company is now located at 2400 W. Madison St.

WYATT SALES Co., formerly located at the National Bldg., Cleveland, Ohio, has moved to 376 Rockefeller Bldg., Cleveland.

E. L. ESSLEY MACHINERY Co., Chicago, Ill., has moved into new offices in a building of its own at 825-845 Rees St.

Obituary

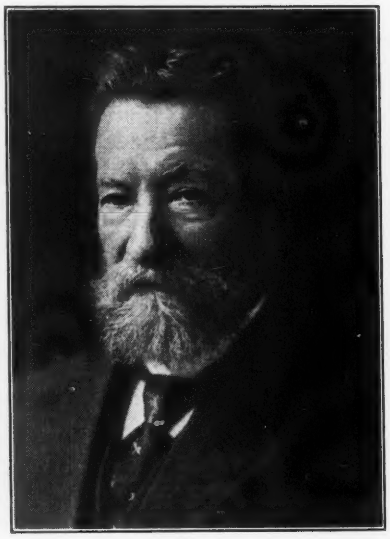
Hugo Bilgram

Hugo Bilgram, president of the Bilgram Gear & Machine Works, Inc., Philadelphia, Pa., pioneer manufacturers of gear-cutting machinery, died at his home at Moylan, Pa., August 27, at the age of eighty-five.

Mr. Bilgram was born in Memmingen, Bavaria, in 1847. He graduated from the Polytechnic School of Augsburg, Germany, in 1865, and after having worked for four years as a machinist and draftsman in Germany, he arrived in the United States in 1869, going directly to Philadelphia, where he has lived ever since.

After having been employed for some years by various Philadelphia firms, he entered, in 1876, the employ of Brehmer Bros. Co.; and when this company decided to remove the plant to Germany, Mr. Bilgram was placed in charge of the American branch, as a partner. In 1879, he became sole owner of the plant, which was incorporated under the present name—the Bilgram Gear & Machine Works, Inc.

In 1883, Mr. Bilgram built his first bevel-gear generator, which became known throughout the world. In recognition of this development, he received the Elliott Cresson gold medal from the Franklin Institute. He also devoted his engineering skill to the designing and building of automatic cigarette machines, and in his earlier experience, to improvements in steam engines.



Hugo Bilgram

Outside of his engineering work, Mr. Bilgram gave much attention to microscopy and also made a thorough study of the subject of economics. In 1889, he published a treatise on "Involuntary Idleness"; in 1914, "The Cause of Business Depressions"; and in 1928, "Remedy for Over-production and Unemployment."

Coming Events

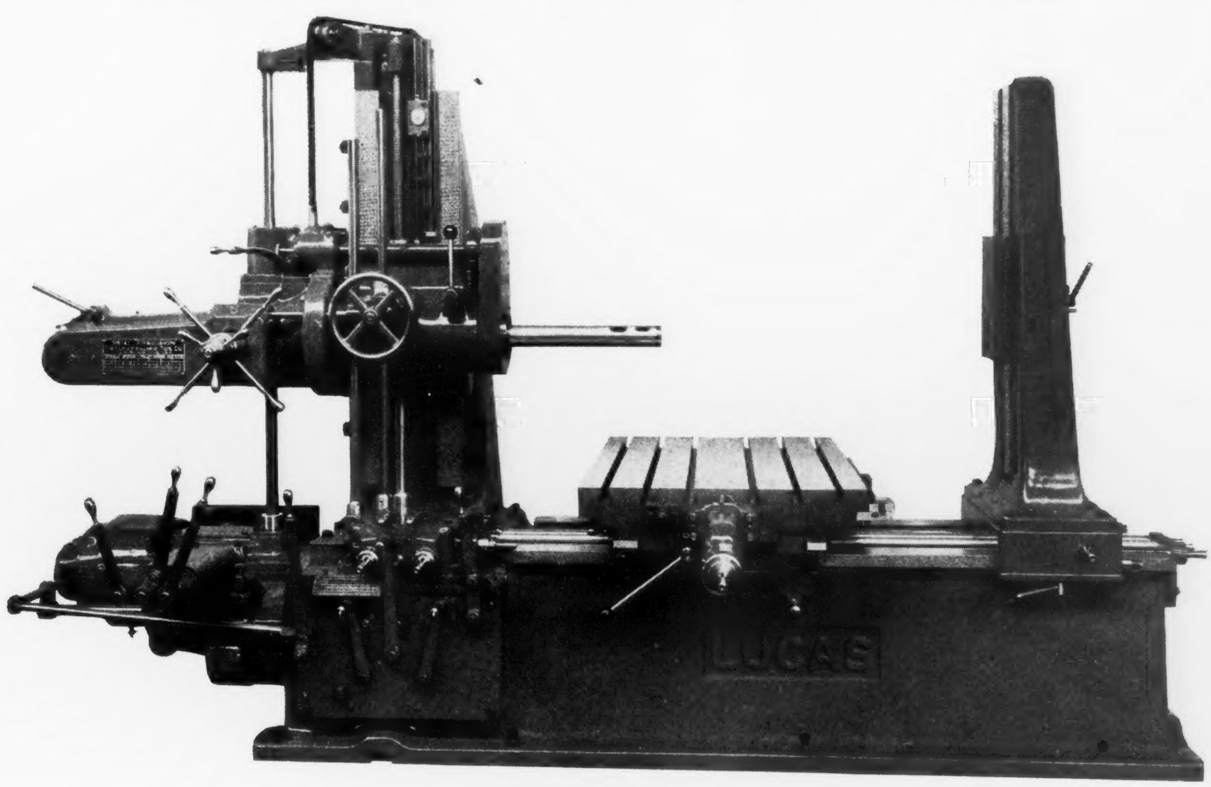
OCTOBER 3-7—National Metal Congress, Buffalo, N. Y., sponsored by the American Society for Steel Treating, 7016 Euclid Ave., Cleveland, Ohio, with the cooperation of the American Society of Mechanical Engineers, the American Institute of Mining and Metallurgical Engineers, the American Welding Society, and the Wire Association.

OCTOBER 3-7—Twenty-first Annual Congress of the National Safety Council, Washington, D. C. Office of the Secretary, 20 N. Wacker Drive, Chicago, Ill.

OCTOBER 3-8—Fourteenth National Metal Exposition to be held in the 174th Regiment Armory, Buffalo, N. Y. W. H. Eisenman, secretary, American Society for Steel Treating, 7016 Euclid Ave., Cleveland, Ohio.

DECEMBER 5-9—Annual meeting of the American Society of Mechanical Engineers in the Engineering Societies Building, 29 W. 39th St., New York City. Calvin W. Rice, secretary.

DECEMBER 5-10—Tenth National Exposition of Power and Mechanical Engineering at Grand Central Palace, New York City.


LUCAS

Classified Contents of this Number

Good Painting Helps to Sell Machines

Machines are seldom bought simply because of their performance. The buyer is not satisfied with a machine, no matter how well it may meet requirements, unless the construction and finish are pleasing to the eye. Paint, therefore, plays an important part in the sales of machines because, even when the design is pleasing, a good paint job adds materially to the appearance.

A machine well designed and built deserves the right kind and quality of paint. November MACHINERY will describe the materials and methods used in obtaining a first-class finish on a well-known make of machine tools. The painted finish must not only be good looking, but must stand up under years of hard service. The article will tell how that can be done.